



**PROVINCE OF NOVA SCOTIA**  
**DEPARTMENT OF PUBLIC WORKS**

**BUILDING INFRASTRUCTURE DESIGN AND CONSTRUCTION**

**DC350**  
**DESIGN REQUIREMENTS MANUAL**

**June 2024**

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## PREFACE

### What is The DC350 - Design Requirements Manual?

The DC350 Design Requirements Manual provides a comprehensive description of the minimum acceptable design requirement standards for buildings designed, constructed, owned, and maintained by the Province of Nova Scotia.

The DC350 Design Requirements are to be read in conjunction with project specific scope of work documents.

### How is the DC350 Design Requirements Manual Organized?

The DC350 consists of two main Parts.

- Part 1: General Design Requirements Overview.
  - Description of minimum design requirements organized by Division and Section as follows:
    - Information is numbered in conformance with the Master Format List of Divisions and Sections Titles and Numbers, published jointly by Construction Specifications Canada and the Construction Specifications Institute (CSI), and are arranged in their standard 50 - Division format.
- Part 2: Design Requirements by Typology documents are narrow in scope, provide specific standards for the topics covered, and specify detailed requirements regarding materials and assemblies.
  - Electrical Structured Cable Guidelines Appendix
  - Appendix Documents specific to the Education Specific Typology including:
    - Education Facilities Performance Criteria, Appendix A
    - Education Facilities Drawing Review Process, Appendix B
    - Education Facilities Drawing and Sketch Details, Appendix C
    - Education Facilities Gymnasium Floor Layouts, Appendix D

### **How does the DC350 address the various authorities, codes, and standards used?**

Where reference is made in the DC350 to:

- Jurisdictional Authorities:
  - It shall mean all authorities having, within their constitutional powers, the right to enforce the laws of the place of the Work.
- Codes, Standards, or References
  - Where the edition date is not specified, the code, standard or reference is considered that of the latest edition, including amendments, approved by the issuing organization.
  - In the case of a code, standard or reference date that is updated during the design or construction of a project, the date that is effective on the tender release date of the project will be the code, standard or reference that applies
  - Where such references are at variance with each other, the more stringent requirements shall govern.
  - In some specific cases an older standard may be specifically referenced; this situation will be specially noted as such in the DC350 as it is not typical.

### **How does the DC350 address manufacturer's directions, instructions, and specifications?**

- Where reference is made to the manufacturer's directions, instructions, or specifications, they shall be only those that are printed and issued for the specific project.
- Reference shall include information on storing, handling, preparing, mixing, installing, erecting, applying or other matters concerning the materials with which they represent.

### **What considerations should be given to products and manufacturers included in the DC350?**

- Products, manufacturers, and systems are listed in the DC350 in order to provide a reference Standard of Acceptance.
- Products, manufacturers and systems specified in the DC350 indicate examples of products or manufacturers that meet the minimum design guideline requirements of the DC350. Other products and manufacturers that meet the DC350 stated design guideline requirements are considered Acceptable Alternates and can be used in the project specifications.
- A Variance form Request shall be filled out for all products that do not meet the DC350 Design Guideline.

### **What is the Request for Variance process during the design process?**

- Requests for variances from the products, manufacturers, and systems in the DC350 may be made during the design process for the specific projects using the Variance Form included in the DC350 Manual.
- Acceptable alternative products, manufacturers, and systems, equal to or exceeding the specified standard of acceptance, will be considered by the Department, and are encouraged.
  - Requests for Variances for a specific product must be provided in writing by the Consultants to the Minister's Representative by using the Variance Form included herein and must include an explanation of the reason for the request, including cost impact of using the product.
  - The Minister's Representative must be provided with sufficient information and shall be allowed a minimum of 10 working days to evaluate the request. If applicable, include with information, any changes required in the work to accommodate such products or systems.
  - Incorporate such requested products or systems only when approved in writing by the Minister's Representative.
  - The Department's approval or rejection of the requested product or system is for a specific project for which the review is being sought. A separate request is required for each project where a product is desired to be considered.
  - The Minister reserves the right to refuse to evaluate any requests received after the Schematic Design Stage for the project.
  - Variances which have not been submitted for approval during the Schematic Design Stage and subsequently approved by the Minister's Representative, may be rejected. In such a case, redesign costs will not result in additional design fees to the Minister.

### **What is the Minister's Representative's process with respect to Requests for Variance?**

- The Department reserves the right to review, comment, accept or reject products which are not the design standards incorporated in the DC350.
- The Department reserves the right to reject products which have failed to perform satisfactorily or meet DC350 stated requirements in previous NS government projects.



### **What is the Request for Variance process during the tender process?**

- Request for Variance by Manufacturers during the tender period must be made prior to the appropriate time outlined in the project's tender documents to allow for inclusion in addenda. Requests after this time stated in the Tender documents will not be considered.

### **Governance: In the event of differences between portions of the DC350**

- In the event of conflicts between the various Parts of the DC350, or between the DC350 and its appendices, the following shall apply:
  - The executed Agreement between the Minister and any contracting body shall govern over all parts of the DC350 and Design Briefs.
  - Project-specific Design Briefs shall govern over the DC350.
  - Where requirements of DC350 Part 1 General Design Requirements have not been changed, specifically exceeded, or amended in Part 2, the requirements of Part 1 shall be considered the minimum standard.
  - Where requirements of DC350 Part 2 Design Requirements by Typology, including Electrical and Education Specific Standards have changed, specifically exceeded, or amended information provided in Part 1, the Requirements of Part 2 shall govern.
  - DC350 documents of a later date shall govern over DC350 documents of an earlier date.
  - DC350 schedules shall rule over DC350 drawings.
  - DC350 drawings with figured dimensions shown on a drawing shall govern over dimensions scaled on drawings.
  - DC350 drawings of larger scale shall govern over those of smaller scale.

**END**

**DC350 REQUEST for VARIANCE**

	<b>Provide Variance Data Below</b>
<b>Date</b>	
<b>Firm</b>	
<b>Project</b>	
<b>Minister's Representative Internal Project Number</b>	
<b>Variance Discipline (A/M/E/C)</b>	
<b>Requesting Variance from DC350</b>	
Part	
Section	
Specification/Appendix	
<b>Reason for Variance</b>	
<b>Proposed Alternate</b>	
<b>Estimated Cost/Credit</b>	
<b>Consultant Signature</b>	
<b>Minister's Representative Signature (A/M/E/C):</b>	
Date	
Approved	
Rejected	
Note: Variance applies to this specific project only.	
Note: Minister's Representative signatory is Senior A/M/E/C	

## DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS

1. Information relates to DPW requirements for Bidding and Contracting including bid solicitation, instructions to bidders, bid forms and supplements, bidding addenda, agreements, bonding and certificates, general conditions of contract, supplementary conditions, and contract modifications.
2. The bid and contract administration process is detailed in the Departments master document entitled, "Nova Scotia Public Sector Construction Contract Guidelines".
3. A copy of the latest edition of the Nova Scotia Public Sector Construction Contract Guidelines is available to Consultants through the Province's website at
4. [https://procurement.novascotia.ca/media/54534/guide\\_construction%20contract%20guidelines%2017-06-15.pdf](https://procurement.novascotia.ca/media/54534/guide_construction%20contract%20guidelines%2017-06-15.pdf)
5. Refer to the Contract Agreement for description of responsibilities, unless specified otherwise.
6. The Government of Nova Scotia is committed to fostering economic development by giving every capable Nova Scotia supplier the opportunity to do business with the government and encouraging Nova Scotia businesses to be competitive and sustain quality product development. When alternative products, which are manufactured in Nova Scotia, are available, Consultants are asked to consider the quality and value of these products for possible inclusion of these products in the specifications as the Standard of Acceptance or Acceptable Alternative.
  - 6.1. Consultants are required to prepare and submit to the DPW Representative, as part of the Design Development package, a Supplier Development list of the Nova Scotia suppliers and manufacturers that will be specified in the final documents. The consultant will submit an updated list with every submission. See the Province of Nova Scotia Sustainable Procurement Policy, latest edition, which is also available on the Province's website at

<https://www.novascotia.ca/treasuryboard/manuals/PDF/300/30301-02.pdf>

### Section 00 20 00 Instructions to Bidders

1. General
  - 1.1. The Instruction to Bidders Section is developed and reviewed by DPW staff. A copy of the Instruction to Bidders Section is available to Consultants through the DPW Design Team Leader or Project Manager for inclusion in the Contract Documents set.

**Section 00 31 24 Environmental Assessment Information**

1. General

- 1.1. The Environmental Investigation Report shall be carried out and distributed by DPW as outlined in the Contract Agreement or as directed by DPW staff.
- 1.2. If hazardous materials or conditions are known to exist, appropriate tests shall be identified and carried out as per the Contract Agreement.

**Section 00 31 32 Geotechnical Data**

1. General

- 1.1. The Geotechnical studies shall be carried out and distributed as outlined in the Contract Agreement.
- 1.2. If hazardous materials or conditions are known to exist, appropriate tests shall be identified and carried out as per the Contract Agreement.

**Section 00 40 00 Procurement Forms and Appendices**

1. General

- 1.1. When project documents are being prepared for public tender, the Consultant shall obtain a copy of the latest edition of the Department's Master Front End Document Bid Forms and Appendices.

**Section 00 52 00 Agreement Forms**

1. General

- 1.1. The Consultant shall obtain a copy of the latest edition of the Department's Master Front End Document including the agreement between the Minister and the Contractor.

**Section 00 60 00 Project Forms**

1. General

- 1.1. Refer to Nova Scotia Construction Contract Guidelines for requirements regarding Bid Security, Performance Assurance and Maintenance Bonds, as represented in the DPW Master Front End documents.
- 1.2. Certificates of Compliance: Use DPW standard forms for Contract Administration.



**Section 00 72 00 General Conditions**

1. General

- 1.1. For Design-Bid-Build projects the Consultant shall obtain a copy of the latest edition of the Department's Master Document General Conditions.

**Section 00 73 00 Supplementary Conditions**

1. General

- 1.1. The Department has developed a master document providing examples of ways the "General Conditions of Contract" might be modified. DPW will provide guidance on Supplementary Conditions that are appropriate for the project.

**Section 00 90 00 Revisions, Clarifications and Modifications**

1. General

- 1.1. The preparation and coordination of Bidding Addenda shall be carried out and distributed as outlined in the Contract Agreement.

**Section 00 94 00 Record Modifications**

1. General

- 1.1. The preparation and coordination of Contract Modifications, including Consultant Change Orders, Contractor Change Orders, Change Orders and Change Directives, shall be carried out as outlined in the Contract Agreement.

**END**

## Division 01 - General Comments

1. Information relates to DPW General Requirements for the project including but not limited to payment procedures, administrative requirements, quality requirements, temporary facilities and controls, product requirements, execution requirements, facility operation, facility decommissioning, facility commissioning, and functional performance testing.
2. Co-ordinate Division 01 with DPW General Conditions of the Contract.
3. Discuss content of DPW Division 01 master documents with DPW staff. For large scope projects additional long form NMS Division 01 sections will be required. Incorporate content and references from the DPW Division 01 master documents provided by the DPW staff into any additional long form NMS Division 01 sections as required.

## Section 01 00 00 General Instructions

1. General
  - 1.1. The Department has developed a master document covering general requirements. While suitable for small projects, the document is appropriate as resource material for the Consultant retained for projects of a larger scale.
  - 1.2. Consultants are directed to use the current NMS long form sections where appropriate for projects of a larger scale and to coordinate with the required DPW Agreement, General Conditions, Supplementary Conditions and additional DPW provided Division 01 sections. The master 01 00 00 document contains minimum Departmental requirements for Project Identification Signage, Waste Management and Disposal, Unit Prices, Itemized Prices, Separate Prices, and Alternate Prices, etc.
  - 1.3. A copy of Section 01 00 00 General Instructions from the DPW Master Document is available to Consultants.
  - 1.4. Scheduling of Work
    - 1.4.1. Activities which may result in odor or construction dust dispersal throughout occupied areas of the building should be scheduled during unoccupied times. Consider direction of prevailing winds, location of fans and air handling equipment to minimize odor and dust dispersal throughout the building. Execute work as quietly as possible in and around occupied building. Coordinate scheduling of noisy operations with the facility's administration to achieve least disturbance to occupants.

## Section 01 14 00 Work Restrictions

### 1. General

#### 1.1. Contractor's Use of Site

- 1.1.1. Contractor to carry out work with a minimum of inconvenience to adjacent landowners.
- 1.1.2. Contractor to coordinate work to not inconvenience building occupants or hinder use of buildings when performing alterations or additions within an existing occupied building.
- 1.1.3. The Contractor shall provide and maintain continuity of fire separations, and safe means of egress when performing work in existing and occupied buildings.
- 1.1.4. Construction site to be maintained in a clean and neat condition; provide removal of litter and construction waste from the job site on a regular basis.
- 1.1.5. All existing building and on-site materials for ducts, vents and diffusers to be sealed from dust and odors during construction.

**Section 01 21 00 Allowances**

1. General

- 1.1. The Department generally does not specify cash allowances for construction contracts. If cash allowances are desired, written approval from the DPW Representative must be obtained.

## Section 01 29 00 Payment Procedures - Schedule of Values

### 1. General

- 1.1. Within 10 days of the Award of Contract the successful contractor, shall submit a breakdown of their prices, using the latest edition of the DPW Master DC250-09 - Schedule of Values Form, a sample of which is provided in master DPW Section 01 29 00 Payment Procedures, unless directed otherwise by the DPW project Design Team Leader.
- 1.2. The breakdown for Payment Applications will be on the form approved by the DPW Representative, a sample of which is included at the end of Section 01 29 00 Payment Procedures, unless directed otherwise by DPW staff.



**Section 01 35 00 Special Procedures**

1. General

- 1.1. Refer to Special Procedures sections such as Section 01 35 21 - LEED Requirements or Section 01 35 43- Environmental Procedures for required administrative, procedural, and submission requirements.

**Section 01 35 29 Occupational Health and Safety Requirements**

1. General

- 1.1. Use the latest edition of the DPW Master Document Section 01 35 29 - Occupational Health and Safety Requirements, a copy of which is available to consultants through the DPW Design Lead.

## Section 01 41 00 Regulatory Requirements

### 1. General

- 1.1. Ensure all code and regulatory requirements are met and appropriately referenced throughout the Project Manual and Drawings.
- 1.2. Determine detailed requirements of jurisdictional authorities. Ensure the design and construction documents conform to all acts, laws, codes and regulations in force in the location of the project.
- 1.3. Ensure construction documents provide for giving necessary notices, obtaining permits, making payment for fees and inspections, and furnishing certificates as evidence that the work, as installed, conforms with the laws and regulations of governing authorities.
- 1.4. Permits: Ensure construction documents provide for acquisition of appropriate permits for site development, including but not limited to:
  - 1.4.1. all applicable Provincial Government Departments
  - 1.4.2. Office of the Fire Marshall's Authorities Having Jurisdiction
  - 1.4.3. Municipal Authorities
  - 1.4.4. Other jurisdictional authorities
  - 1.4.5. Municipal Building Permits are not required on some crown construction projects. The requirement for Municipal Building Permits will be confirmed by the Design Team Lead in writing.
- 1.5. Environment Act.
  - 1.5.1. Ensure the Contractor is familiar with the requirements of the Environment Act and the Regulations pursuant to the Act.

## Section 01 50 00 Temporary Facilities and Controls

### 1. General

- 1.1. Where the project scope requires extensive temporary facilities ensure that long form NMS specifications sections 01 51 00 -Temporary Utilities and or 01 52 00 Construction Facilities are provided for all temporary facility requirements during construction.
- 1.2. Fire Separations
  - 1.2.1. Where fire separations are required in the project, provide a written description of the entire system being used to achieve fire separations with appropriate UL/ULC numbers.
  - 1.2.2. Show on architectural drawings, locations, extent and ratings of fire separations and protections. Additionally, identify such designated fire separations and protections on one complete set of electrical floor plan "power" drawings.
- 1.3. Dangerous Goods Management.
  - 1.3.1. Fuels and lubricants to be stored, transported and used according to provincial regulations.
  - 1.3.2. The Contractor is not permitted to construct machinery maintenance depots, refueling stations, storage yards, or any type of installation, that could possibly cause contamination to a watercourse through the disposal of human waste, oil, grease, or other deleterious material.
  - 1.3.3. Gasoline, waste oils and lubricants to be retained in a closed container and disposed of in conformance with provincial regulations.

## Section 01 57 00 Temporary Controls

### 1. General

- 1.1. Where the projects scope requires temporary control measures including but not limited to traffic control, protection of public, protection of adjacent properties and the environment, provide the long form Temporary Controls NMS specifications and detail the required controls and procedures during construction.
- 1.2. Also refer to Part 1 Section 1 Site Planning and Division 2 sections for additional requirements.
- 1.3. Where the Work requires temporary Erosion and Sediment Control measures the Consultant is required to include with the Construction Drawings an Erosion and Sediment Control drawing identifying construction limits, access points, location and type of Control measure and details of required Erosion and Sediment Control measures.
- 1.4. Where the Work requires temporary Erosion and Sediment Control measures ensure that the following is specified in the construction documents.
  - 1.4.1. All sediment and erosion controls to be used on a specific project are in accordance with the "Erosion and Sedimentation Control Handbook for Construction Sites" (Latest Edition; DOEL) and Division 7 of the Standard Specification Highway Construction and Maintenance" (Latest Edition). The contractor to carry out regular inspections of all erosion and sediment controls ensuring proper installations are maintained, especially prior to and after major storm events.
  - 1.4.2. All projects involving site work where erosion may be an issue, will require the contractor to engage a full-time on-site representative who has received the Certificate of Training for successful completion of the Erosion and Sediment Control workshop offered by the Centre for Water Resource Studies (CWRS), Dalhousie University and DPW.
  - 1.4.3. The Contractor shall have an Erosion and Sediment Control Plan approved by DPW prior to construction.
- 1.5. Watercourses/Culverts.
  - 1.5.1. All work to conform to the "Nova Scotia Watercourse Alteration Standard" (Latest Edition; DOE).

- 1.5.2. Prior to work on culverts, a geotextile silt fence shall be installed on both sides of the watercourse at a location delineating the edge of the buffer zone.
- 1.5.3. The buffer zone shall be determined by the Federal Department of Fisheries and Oceans (DFO) and is provided to prevent sediment from entering the watercourse.
- 1.5.4. Design of culverts, extension of culverts or alteration of water courses affecting fish passage must follow the “Nova Scotia Watercourse Alteration Standard” and the Environment Act developed by the Nova Scotia Department of Environment. Design based on these documents shall be forwarded to the Department of Environment for review and approval.

**Section 01 60 00 Product Requirements**

1. General

- 1.1. Where project scope requires, ensure that long form NMS specifications are provided for all materials and equipment requirements.

## Section 01 70 00 Contract Closeout

### 1. General

- 1.1. Use the latest edition of the DPW Master Document Section 01 70 00 - Contract Closeout, a copy of which is available to consultants through the DPW project Design Team Leader.
- 1.2. Commissioning and Functional Performance Testing (FPT)
  - 1.2.1. Functional Performance Testing is defined as the activities required, upon reaching Substantial Performance of the Work, to test and ensure correct operation of identified building systems based on the terms of the Contract.
  - 1.2.2. Specific commissioning and functional performance requirements are specified throughout the technical portions of the DC350 including but not limited to, Part 1 Section 2- FSS-G.
  - 1.2.3. Contract documents to specify all commissioning requirements including but not limited to the following:
    - 1.2.3.1. Provision of full Commissioning services for building systems
    - 1.2.3.2. Coordination with DPW staff for their Functional Performance Testing (FPT).
    - 1.2.3.3. identification of required attendance by all pertinent parties, including consultants, contractors, sub-contractors and DPW staff.
    - 1.2.3.4. identification of minimum time commitments required for each party identified to complete their roles and responsibilities.
    - 1.2.3.5. description of roles and responsibilities of each party
    - 1.2.3.6. LEED required specific commissioning procedures on LEED projects.
- 1.3. DPW will commence a Functional Performance Testing (FPT) Program independent of other processes, upon receipt of written verification from the General Contractor that:
  - 1.3.1. All systems are complete and operational in all respects.



- 1.3.2. All specified reports and documents have been submitted and approved.
- 1.3.3. All tests, commissioning and start-up processes are complete.
- 1.3.4. All demonstrations have been completed and documented.
- 1.4. All defects and deficiencies identified during the construction process and during the commissioning of all systems have been corrected.
- 1.5. Allow for 1 day for every 15,000 square feet or portion thereof.
- 1.6. Provide qualified tradespersons and all manufacturer's technical representatives as required by the owner. Make all arrangements and pay for all associated costs.
- 1.7. FPT shall be performed on all systems referenced in the contract documents which may include, but not be limited to, the following: all mechanical and electrical systems, architectural systems and site systems.
- 1.8. The correction of all deficiencies identified throughout the project associated with the Work shall be a condition of Substantial Performance application by the Contractor applying for Substantial Performance.
- 1.9. Submission of As-Builts/Record Drawings
  - 1.9.1. Construction documents shall require the Contractor to submit one set of As-Built drawings to the Consultant, on completion of the work accurately showing deviations in the Work so that the Consultant is able to modify contract drawings for submission of Record Drawings under the Minister-Contract Agreement, or Standing Offer Agreement, as applicable.
- 1.10. Extended Warranties
  - 1.10.1. Ensure Extended Warranties are submitted for each of the following items:
    - 1.10.1.1. Landscaping - Refer to Division 32
    - 1.10.1.2. Pre-cast / tilt-up concrete - Refer to Sections 03 41 00, 03 45 00
    - 1.10.1.3. Finish Carpentry & Millwork, & Architectural Wood Casework Refer to Sections 06 00 00, 06 46 00
    - 1.10.1.4. Architectural Woodwork Refer to Section 06 00 00
    - 1.10.1.5. Roofing

- 1.10.1.5.1. Steep Slope roofing - Refer to Section 07 30 00
  - 1.10.1.5.2. Membrane (product) - Refer to Section 07 00 00
  - 1.10.1.5.3. Workmanship - Refer to Section 07 00 00
  - 1.10.1.6. Damp proofing & Waterproofing - Refer to Section 07 00 00
  - 1.10.1.7. Joint Protection - Refer to Section 07 90 00
  - 1.10.1.8. Openings - Refer to Section 08 00 00
  - 1.10.1.9. Wall Finishes - Refer to Section 09 00 00
  - 1.10.1.10. Floor Finish - Refer to Section 09 00 00
  - 1.10.1.11. Gymnasium Sports Floor - Refer to Sections 09 64 00, 09 67 00 (Performance & Structural Integrity)
  - 1.10.1.12. Visual Display Boards - Refer to Section 10 11 00 (Manufacturer's Warranty)
  - 1.10.1.13. Equipment (Food Storage) - Refer to Section 11 00 00
  - 1.10.1.14. Elevators/Escalators - Refer to Section 14 00 00
  - 1.10.1.15. Energy Recovery Wheels - Refer to Section 23 72 00
  - 1.10.1.16. Humidity Control Equipment - Refer to Section 23 84 00
  - 1.10.1.17. Generators - Refer to Section 26 32 00
  - 1.10.1.18. Transfer Switches - Refer to Section 26 36 23
  - 1.10.1.19. TVSS - Refer to Section 26 43 00
  - 1.10.1.20. Emergency Lighting - Refer to Section 26 52 00
  - 1.10.1.21. Exit Signs - Refer to Section 26 53 00
  - 1.10.1.22. Structured Cabling - Refer to Div.27 and Structured Cabling Guidelines
- 1.11. Refer to the division or section referenced above in the Part 1 of the DC350 for extended
- 1.12. Warranty years required.
- 1.13. Extended Warranties shall commence on the termination of the standard one-year warranty specified in GC 16 of the Department's General Conditions of Contract. Each extended warranty to be submitted on a standard Form of Warranty, a copy of which can be obtained from Department staff.

- 1.14. Specified Extended Warranties are to be provided at no additional future cost to the Province of Nova Scotia.
- 1.15. Waste Management and Disposal
  - 1.15.1. Where the short form Section 01 00 00 DPW master document does not adequately provide for the necessary requirements for cleaning, waste management and disposal provide a long form Section 01 74 00 - Cleaning and Waste Management section edited from an approved NMS master.
  - 1.15.2. Provide on-site facilities for collection, handling and storage of anticipated quantities of reusable and recyclable materials.
  - 1.15.3. Source separate materials to be re-used or recycled into specified sort areas.
  - 1.15.4. Dispose of construction debris (unable to be reduced/reused/recycled) in separated waste streams as outlined by the local waste management program.
  - 1.15.5. For LEED projects all construction waste, is to be tracked and documented in accordance with CaGBC LEED requirements.
- 1.16. Operation and Maintenance Manuals
  - 1.16.1. Where Operation and Maintenance Manuals are required for project completion ensure that Manuals meet the requirements of the format outlined in the short form Section 01 00 00 DPW master document.
  - 1.16.2. Where project scope requires, including new facility construction, Operation and Maintenance Manuals shall be provided as part of a Building Management Manual (BMM) which shall be consistent with current Master Format 01 90 00 Lifecycle Activities subsections standard specifications or 'NMS Complete' Section 01 91 51 Building Management Manual (BMM) standard specifications. The Consultant shall ensure that the BMM explains:
    - 1.16.2.1. what systems, equipment and components have been incorporated into the building
    - 1.16.2.2. why these systems, equipment and components have been selected,

- 1.16.2.3. how the design and operating concepts of the sub-systems, systems, and integrated systems are accomplished, and
- 1.16.2.4. training materials, including but not limited to, digital recordings of all training sessions as specified throughout the Contract Documents.
- 1.16.3. For new construction or major retrofit, the Consultant shall ensure that specifications include the NMS long form latest version specification for 'Building Management Manuals (BMM)' appropriate to the project, and consistent with specific building information requirements as specified in individual sections of the DC350.

**Section 01 78 00 Closeout Submittals**

1. General

- 1.1. Refer also to DPW Master Section 01 70 00 Contract Closeout for standard submission requirements. Supplement the requirements of 01 70 00 with long form NMS Section 01 78 00 specifications where appropriate, to meet the needs of the project scope (ex. LEED).

**Section 01 80 00 Performance Requirements**

1. General

- 1.1. Where the projects program requires, ensure that long form NMS specifications are provided for all Performance Requirements including but not limited to Sustainable Design Requirements such as requirements for LEED Certification.

**END**

## **DIVISION 02 EXISTING CONDITIONS**

### **Section 02 00 00 Existing Conditions**

#### **1. General**

- 1.1. Refer to Part 1 Section 1 Site Planning, Part 1 Section 2 Division 01 and Divisions 31- 33 for additional design requirements related to the site.**

## Section 02 40 00 Demolition and Structure Moving

1. Existing buildings and surface features
  - 1.1. Provide under the direction of an Engineer an existing conditions survey of buildings, trees, lawns, fencing, service poles, wires, paving, survey benchmarks, wells, monitoring wells, sewage treatment systems, monuments and any other site features which may be affected by the work.
  - 1.2. Protect adjacent buildings, underground utilities, and surface features, not intended for demolition, which may be affected by work, from damage while Work is in progress.
  - 1.3. Prevent debris from blocking city streets, sidewalks and drainage features.
  - 1.4. Ensure safe passage of persons around the demolition area.
2. Environmental
  - 2.1. Provide erosion and sediment controls to ensure no sediment leaves the work site.
  - 2.2. Keep noise to acceptable levels and conduct work within normal working hours.
  - 2.3. Suppress dust during demolition activities as directed by the Engineer.
3. Decommissioning of Services
  - 3.1. Notify municipality and service providers of intent to decommission the site and arrange to have utilities and services disconnected.
  - 3.2. Have wells decommissioned in accordance with the Nova Scotia Environment Act, Well Act Construction Regulations (Latest Edition).
  - 3.3. Have onsite sewage system decommissioned in accordance with Nova Scotia Environment Act, Onsite Sewage Disposal System Regulations. (Latest Edition).
4. Disposal
  - 4.1. Dispose of all regulated hazardous buildings materials and equipment in accordance with all acts, regulations, and authorities having jurisdiction at the place of work.
  - 4.2. Dispose of regulated construction and demolition debris waste at a NSDOE permitted facility.



- 4.3. Dispose of non-regulated waste at a facility approved by the DPW Representative.
- 4.4. For LEED projects all materials are to be documented as per CaGBC LEED system selected for the project by the DPW Representative.
5. Salvage, reuse, recycling
  - 5.1. Encourage salvage, recycling, and reuse of materials and equipment from any building or portion of a building to be demolished.
  - 5.2. All Materials are to be documented as per CaGBC LEED system selected for the project by the DPW Representative.

**Section 02 50 00 Site Remediation**

1. General

1.1. Contaminated Material

1.1.1. Ensure any material contaminated by the accidental spilling of fuel, anti-freeze, oil or grease that, in the judgement of the Consultant, may cause contamination to soil, streams or lakes, is loaded and transported to an area by the Contractor, where it can be disposed of in manner that meets all Provincial regulations. Report spills in excess of quantities outlined in Schedule A Emergency Spill Regulations to the DPW Representative.

1.2. Contaminated Sites

1.2.1. Notify regulatory authorities of remedial activities to be conducted.

1.2.2. Utilize a recognized environmental site professional acceptable to the DPW Representative, to oversee the remediation of contaminated sites.

1.2.3. Dispose of all contaminated soil at a DOE permitted facility in Nova Scotia or at a specialized disposal facility out of province acceptable to the DPW Representative and the receiving province.

1.2.4. Transport and dispose of any free phase petroleum product to a NSDOE permitted facility by a TDG trained carrier.

1.2.5. Conduct remedial activities in a manner that prevents detrimental environmental impacts.

1.2.6. Take action necessary to minimize water exposure to the contaminated area.

1.2.7. Contain and test water from the area of remediation to determine contaminant concentration and water disposal options.

**END**

## DIVISION 03 CONCRETE

### Section 03 00 00 Concrete - General

1. Information relates to technical requirements for concrete, including falsework, concrete forms and accessories, concrete reinforcement, cast-in-place concrete, precast concrete, cementitious decks and underlayment, grouts, mass concrete, concrete restoration and cleaning.
2. Design
  - 2.1. All concrete work shall be designed by a Structural Engineer licensed to practice in the Province of Nova Scotia.
  - 2.2. Design footings, foundations, floor slabs including slabs on grade, retaining walls, and other structural concrete to satisfy the necessary requirements indicated by the subsurface soils investigation and report by a Geotechnical Engineer, licensed to practice in the Province of Nova Scotia.
  - 2.3. Consultant to ensure that falsework is designed and constructed in accordance with CAN/CSA S269.2-16.
3. Concrete sealer, form release and stripping agents to be non-toxic, biodegradable and have zero or low VOC's.
4. Inspection and Testing, Source Quality Control:
  - 4.1. The consultant shall ensure that the project manual provides for appropriate inspection and testing for slump, strength, material and air entrainment. Authorization and payment for such tests will be as per the project specific contract and agreements.

## Section 03 10 00 Concrete Forming and Accessories

1. Materials
  - 1.1. Formwork
    - 1.1.1. For concrete without special architectural features, use plywood and wood formwork materials to CSA O121-17, CSA O86-2014, CSA O153-13 (R2017).
    - 1.1.2. For concrete with special architectural features, use formwork materials to CSA A23.1-14/A23.2-14.
  - 1.2. Form Ties:
    - 1.2.1. Removable or snap-off purpose made metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm in diameter in the concrete surface.
  - 1.3. Form Release Agent:
    - 1.3.1. Chemically active, non-staining, release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps.
  - 1.4. Form Stripping Agent:
    - 1.4.1. Colourless, non-staining, mineral oil, free of kerosene, with viscosity between 70 and 110s Saybolt Universal at 400 C, and having a minimum flashpoint of 1500 C.
2. When complicated concrete formwork is required, or when concrete work requires structural design of formwork:
  - 2.1. Shop drawings, as required by jurisdictional authorities, shall be submitted to Consultant for review. Such shop drawings shall show tie location, panel layout and joint details where architectural concrete is exposed to view. Shop drawings to be signed and sealed by the design engineer responsible for the design of the form work.
3. Where Architectural Concrete finish is desired:
  - 3.1. Where architecturally detailed, exposed concrete faces are desired, ensure special formwork is appropriately specified, detailed and located.
  - 3.2. Specify type of formwork for each concrete finish specified. Consider layouts for cone ties and other special formwork details.
4. Where water stops are required in the design, ensure their location and extent are either shown or specified.

### Section 03 11 19 Insulated Concrete Forms

1. Insulated concrete form (ICF) building system: factory-assembled and site-installed, stay-in-place polystyrene rigid board insulation panels, with plastic web spacers, interlocking strip and clip accessories, connection ties, and inserts, concrete reinforcement, concrete accessories and cast-in-place concrete is an acceptable construction system.
2. Ensure submittal of shop drawings bearing stamp and signature of a professional engineer registered in the Province of Nova Scotia indicating method and schedule of construction, shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, corner, intersection and connector ties, braces and locations of temporary embedded parts.
3. Ensure system design and installation meets:
  - 3.1. Standard ASTM D1761-12 test methods for mechanical fasteners in polypropylene web material,
  - 3.2. fire resistance rating requirements
  - 3.3. sound transmission requirements, and
  - 3.4. best practices and manufactures requirements for installation methods.
4. Acceptable product/system:
  - 4.1. Nudura or approved equal

## Section 03 20 00 Concrete Reinforcing

1. Material
  - 1.1. Reinforcing Steel
    - 1.1.1. Billet steel, grade 400, deformed bars to CSA G30.18-09 (R2014), unless indicated otherwise.
  - 1.2. Wire Ties
    - 1.2.1. Cold drawn annealed steel wire ties to ASTM A82/A82M-07.
  - 1.3. Chairs, bolsters, bar supports, spacers
    - 1.3.1. To CSA A23.1-14/A23.2-14
  - 1.4. Nylon and Polypropylene Reinforcing Fiber
2. Ensure a design engineer verifies steel type and grade requirements, and fiber type, quantity and distribution requirements. Ensure such steel types and grade requirements are noted on drawings and specified in the appropriate section of the project manual.
3. Ensure concrete reinforcement placing requirements are adequately detailed or specified.

## Section 03 30 00 Cast-in-Place Concrete

### 1. Quality Assurance

1.1. Concrete shall be produced and delivered by a ready-mix plant that is a member of the Atlantic Provinces Ready Mixed Concrete Association (APRMCA) and holds a current "Certificate of Ready Mixed Concrete Production Facilities" issued by the Association.

### 2. Materials: all concrete and materials supplied shall confirm to CSA A23.1-14/A23.2-14.

2.1. Portland Cement: to CAN/CSA A3000-18

2.2. Supplementary Cementing Materials: To CAN/CSA A3000-18

2.3. Cementitious Hydraulic Slag: To CAN/CSA A3000-18

2.4. Water: To CSA A23.1-14/A23.2-14.

2.5. Aggregates: To CSA A23.1-14/A23.2-14, Coarse aggregates to be normal density.

2.6. Air Entraining Admixtures: To ASTM C260/C260M-10a (2016)

2.7. Chemical Admixtures: To ASTM C494/C494M-17

2.8. Non pre-mixed dry pack grout

2.8.1. Composition of non-metallic aggregate Portland Cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 35 MPa at 7 days.

2.9. Curing Compound: To CSA A23.1-14/A23.2-14, white and to ASTM C309-11, Type 1 - chlorinated rubber.

2.10. Pre-molded Joint Fillers

2.10.1. Bituminous impregnated fibre board to ASTM D1751-18

2.10.2. Sponge rubber to ASTM D1752-18, Type I, Flexible grade

2.11. Weep holes: Plastic type tubes, or 90% open polyester mesh by Mortar Net or approved equal

2.12. Dampproof membrane:

2.12.1. Kraft/polyethylene membrane

2.12.1.1. Plain Type

- 2.12.1.1.1. 10 mils thick Polyethylene film bonded to asphalt treated creped kraft.
- 2.12.1.2. Reinforced Type
  - 2.12.1.2.1. Two 75 mils thick polyethylene films bonded each side of asphalt treated creped kraft paper, reinforced with 13 x 13 mm fibreglass scrim.
- 2.12.2. Membrane Adhesive
  - 2.12.2.1. Type recommended by the membrane manufacturer.
- 2.13. Dampproofing
  - 2.13.1. Emulsified asphalt, mineral colloid type, unfilled
  - 2.13.2. To Part 1, Section 2, Division 07, item 07 10 00 references Bituminous sheet waterproofing.
- 2.14. Polyethylene Film
  - 2.14.1. To CAN/CGSB 51.34-M86
  - 2.14.2. 6 mil thickness
- 2.15. Concrete Mixes
  - 2.15.1. Provide concrete in accordance with CSA A23.1-14/A23.2-14.
    - 2.15.1.1. Chemical Admixtures: In accordance with ASTM C494/C494M-17, type, quantity, water reducing strength increasing.
- 3. Cast-in-place concrete work shall be in accordance with CSA A23.1-14/A23.2-14.
- 4. Refer to Part 1, Section 2, Division 32 - Curbs and Gutters for requirements on concrete walks and curbs.
- 5. If radon is suspected or known to occur in the area, ensure appropriate testing for poured concrete is conducted.
  - 5.1. Refer to Section 31 21 00 - Off-Gassing Mitigation requirements.
- 6. 10 to 20% substitution of type 'F' fly ash for portland cement in normal mix design is acceptable.
- 7. Finishing
  - 7.1. Finish concrete in accordance with CSA A23.1-14/A23.2-14.
  - 7.2. Use curing compounds compatible with applied finish on concrete surfaces.



- 7.3. Finish concrete floor to meet requirements of CGSB 81-GP-1M: 1977.
- 7.4. Rub exposed sharp edges of concrete with Carborundum to produce 3 mm radius edges unless otherwise indicated.
8. Dampproof membrane
  - 8.1. Install membrane under concrete slabs-on-grade inside building.
  - 8.2. Lap membrane a minimum of 150 mm at joints and seal with tape.
  - 8.3. Seal punctures in membrane before placing concrete. Use patching material at least 150 mm larger than puncture.
  - 8.4. Contractor to protect from damage or punctures.
9. Tolerances
  - 9.1. Ensure concrete dimensional tolerances are in accordance with CSA A23.1-14/A23.2-14, straight edge method.
10. Field Quality Control
  - 10.1. Provide inspection and testing of concrete and concrete materials in accordance with CSA A23.1-14/A23.2-14. The Minister shall pay for costs of inspection and testing.
11. Admixtures
  - 11.1. Ensure exterior exposed concrete, including walks, curbs, steps and landings have an approved air entraining agent (ASTM) added to the mix to bring the total air content to 6 ½% plus or minus 1 ½%.
12. Grouting
  - 12.1. Grout construction joints in concrete construction to conform to Division 03 - Concrete.
  - 12.2. Grout construction joints in steel construction to conform to Division 05 - Metals.
13. Unless otherwise required in the design, ensure minimum level of finished concrete floors are within 6mm of established elevations in any 6000 mm square area, and is sufficiently even to contact a 3000mm long straightedge with a tolerance of 6 mm. Consider as well, contribution of deflection and shrinkage in suspended slabs. Discuss and resolve issues with DPW project team leader in such situations.
14. Ensure joints in slabs on grade around columns are adequately detailed on drawings or specified in the appropriate section of the project manual.

## Section 03 41 00    Precast Structural Concrete

1. Inspection and Testing, Field Quality Control:
  - 1.1. Ensure that all precast concrete meets the appropriate requirements for design, materials and construction methods as identified in CSA A23.1-14/A23.2-14, CSA A23.3-14 and CSA A23.4-16.
  - 1.2. The inspection and testing company responsible for Source Quality Control will inspect workmanship in installation of precast units and verify completion of work in accordance with the Consultant's design documents.
  - 1.3. Ensure provision for such inspection is specified in the appropriate section of the project manual.
  - 1.4. Inspection and testing company should be same for both source and field quality control.
2. On large projects, consider specifying either more frequent visits or the maximum volume of concrete which may be produced before testing shall be required.
3. Indicate maximum size of holes which can be incorporated in precast units. Provide structural framing for larger holes or indicate method of secondary framing installed under work of this section which is suitable for the specified precast unit.
4. Where accelerated curing is desired, indicate whether low pressure steam or radiant heat and moisture is the method. Specify time of cure corresponding to method employed.
5. Indicate method of finish for all precast units.
6. Warranty
  - 6.1. Where precast concrete or tilt-up wall panels are incorporated into design, make provision in the project manual for extended warranty. Ensure warranty is valid for a period of four (4) years beyond the expiration of the performance assurance requirements specified in the General Conditions. As a minimum, definition of defective work to include but not be limited to: failure or leaking of joints or joint sealant, spalling, visible cracking, changes in colour, excessive weathering of surfaces, warping of units and displacement of units because of failure of anchors or other attachments.

**Section 03 45 00    Precast Architectural Concrete**

1. Source and Field Quality Control to requirements of 03 41 00 - Precast Structural Concrete
2. For cavity wall systems, ensure exterior wall design utilizes the “rain screen” principle, providing a pressure-equalized cavity between the exterior precast concrete and the air barrier. Size and locate vents in the exterior wythe to achieve “nearly instantaneous” pressure equalization of the cavity and protection from rain entry. Refer also to DC350, Part 1, Section 1, Article 10.
3. Ensure the precast or tilt-up concrete wall systems contain an air chamber vent and are weeped to the exterior, pressure equalized and sealed to perform as an air barrier.
4. Where specially finished panels are incorporated into the design, ensure maintenance instructions are provided by the Contractor in the O& M Manual.
5. Warranty
  - 5.1. Where precast concrete or tilt-up wall panels are incorporated into design, make provision in the project manual for manufacturer’s extended warranty. Ensure warranty is valid for a period of four (4) years beyond the date of expiration of performance assurance. As a minimum, definition of defective work to include but may not be limited to: failure or leaking of joints or joint sealant, spalling, visible cracking, changes in colour, excessive weathering of surfaces, warping of units, and displacement of units because of failure of anchors or other attachments.
  - 5.2. Manufacturer’s warranty is to provide guarantee that precast elements will not spall or show visible evidence of cracking, except for unavoidable hairline shrinkage cracks, for the minimum period of four (4) years beyond the date of expiration of performance assurance.
6. Joint breathers are required only where air pressure equalization is required.
7. Provide precast concrete panels having a minimum of 35 mpa concrete with a maximum water absorption of 5% at 28 days.

**END**

## DIVISION 04 MASONRY

### Section 04 00 00 Masonry - General

1. Exterior Materials
  - 1.1. Use of exterior masonry materials to vary in colour, texture and coursing patterns to suit project type, locale and context and to satisfaction of client department.
2. Existing Masonry Repair
  - 2.1. Damaged, cracked or spalled masonry and mortar to be replaced / repaired as directed.
  - 2.2. Cracked and previously repaired mortar to be cut out completely and repointed with type S mortar in a raked joint application. Match replacement masonry work to existing.
  - 2.3. Mock-ups are required on all masonry work, as directed by DPW. Mock-up can form part of Work.
3. Structural Masonry
  - 3.1. Structural systems to meet requirements of the DC350 and are designed by an engineer licensed to practice in the Province of Nova Scotia.
4. Exterior wall design to utilize the “rain screen” principle, providing a pressure-equalized cavity between the exterior cladding and the air barrier. Size and locate vents in the exterior wythe to achieve “nearly instantaneous” pressure equalization of the cavity and protection from rain entry. Unless specified otherwise in this document, design veneered exterior walls so that there is a minimum 25 mm air space between the insulation and the veneer material. Provide baffles in such air space to compartmentalize the cavity into zones of equal pressure.
5. Masonry Procedures
  - 5.1. Masonry work to be done in accordance with CAN3 S304-M84 (R1997) and CSA S478:19, except where specified otherwise.
  - 5.2. Delivery of materials to job site to be in dry conditions.
  - 5.3. Keep materials dry until use.
  - 5.4. Store under waterproof cover on pallets or plank platforms designed to keep masonry off ground.
  - 5.5. Cold Weather Requirements

- 5.5.1. The following precautions are taken when air temperature is below 5 C when preparing mortar:
  - 5.5.1.1. Heat sand slowly and evenly. Do not use scorched sand, having a reddish cast, in mortar.
  - 5.5.1.2. Heat water to 700C maximum; 200C minimum.
  - 5.5.1.3. After combining heated ingredients, maintain temperature of mortar between 50C and 500C until used.
- 5.5.2. Maintain dry beds for masonry and used dry masonry units only. Do not wet masonry units in cold weather.
- 5.5.3. When air temperature is below -4 C, protect and heat masonry to maintain air temperature above 0 C on both sides of walls during operation and for a period of 24 hours after.
- 5.5.4. When air temperature is above -4 C, erect windbreaks to prevent differential freezing of walls.
- 5.6. Hot Weather Requirements
  - 5.6.1. Protect freshly laid masonry from drying out too rapidly by means of waterproof non-staining covering.
- 5.7. Keep masonry dry using waterproof non-staining covering that extends over walls and down sides sufficient to protect masonry from wind driven rain until masonry work is completed and protected by flashing or other permanent construction
- 6. Protect masonry from marking and other damage. Protect completed work from mortar droppings
  - 6.1. Provide temporary bracing of masonry walls until permanent lateral support is in place.
  - 6.2. Installation
    - 6.2.1. Build masonry plumb, level and true to line
    - 6.2.2. Lay out coursing and bond to achieve correct coursing height.
    - 6.2.3. Remove chipped, cracked and otherwise damaged units and replace with undamaged units.
    - 6.2.4. Jointing: Allow joints to set enough to remove excess water then tool with jointer to produce uniform joints.
    - 6.2.5. Cutting:

- 6.2.5.1. Cut out for built-in objects
- 6.2.5.2. Make cuts straight, clean and true from uneven edges.
- 6.2.6. Built-in items required to be built-in to masonry. Prevent displacement of built-in items during construction.
- 6.2.7. Include provisions for movement in design.
- 6.2.8. Openings:
  - 6.2.8.1. Ensure adequate support over all openings in masonry walls through use of filled reinforced block lintels sized to suit opening, width extending a minimum of 150mm either side of opening.
  - 6.2.8.2. Use loose steel lintels only where block lintels are not possible.
- 6.2.9. Control joints: Construct continuous control joints as required.

## Section 04 05 00 Common Work Results for Masonry

1. Mortar and Masonry Grout
  - 1.1. Materials and work for masonry mortar and grout to meet the requirements of CAN/CSA A179-14 except where specified otherwise.
  - 1.2. Mortar types:
    - 1.2.1. Mortar for exterior brick masonry above grade: Type N
    - 1.2.2. Mortar for brick masonry at or below grade: Type M
    - 1.2.3. Mortar for concrete masonry in exterior walls: Type S
    - 1.2.4. Mortar for interior concrete masonry: Type N
  - 1.3. Mortar Mixes:
    - 1.3.1. Mortars to be mixed to requirements of CAN/CSA A179-14, using only dry aggregate. Test for bulking to determine accurate bulking.
  - 1.4. Grout Mixing:
    - 1.4.1. Grout to be mixed to semi-fluid consistency.
2. Masonry Anchorage and Reinforcing
  - 2.1. Masonry reinforcing and connecting to be done in accordance with CSA S304-14 and the NBC latest edition, unless specified otherwise.
  - 2.2. Joint Reinforcement:
    - 2.2.1. For single wythe walls use 9-gauge side rods, welded to a continuous diagonal formed cross rod forming a truss design, galvanized after manufacture.
    - 2.2.2. For cavity walls use 9-gauge, stainless steel, cavity wall tie.
    - 2.2.3. Use of flexible anchors, for tying masonry veneer to wood stud backup, where applicable.
      - 2.2.3.1. 3/16" (5 mm) stainless steel web tie and anchor.
      - 2.2.3.2. Extend tie 75 mm into masonry.
    - 2.2.4. Use of flexible anchors, for tying masonry walls to structural steel: 3/16" (5 mm) galvanized steel web tie and anchor. Extend tie 200 mm into concrete block.
  - 2.3. Dovetail Anchor:
    - 2.3.1. Use of 9-gauge stainless steel anchors to suit dovetail anchor slot, complete with 3/16" (5 mm) stainless steel triangular ties.
  - 2.4. Reinforcing Steel for Reinforced Masonry to be to CAN/CSA A371-14, and CSA G30.18-09 (R2014).

2.5. Use of 3/16" (5 mm) stainless steel web ties and anchors for tying masonry veneer to wood or steel backup where applicable. Extend tie 75 mm into masonry.

3. Masonry Accessories

3.1. Continuous control joint fillers to be installed in control joints as required.

3.2. Weep Hole Vents:

3.2.1. Weep hole vents to be installed in vertical joints immediately over flashing, in exterior wythes of cavity wall construction, at maximum horizontal spacing of 600 mm o.c. Set weep hole to drain at bed level, and at third brick level.

3.2.2. Weep holes to be clear of mortar, and free flowing.

3.3. Masonry Flashing:

3.3.1. Flexible through wall flashing to be installed in masonry in accordance with CSA S304-14 and as follows:

3.3.1.1. Install flashing under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings. Install flashing under weepholes courses. Secure to air barrier at walls.

3.3.1.2. Install 300 mm wide piece of flashing centered over all joints between shelf angles. Bond flashing to angles as recommended by manufacturer.

3.3.1.3. In double wythe walls carry flashing from front edge of masonry, under outer wythe, then up backing not less than 200 mm.

3.3.1.4. Lap joints 150 mm and seal to requirements of manufacturer's printed instructions.

3.4. Masonry Thru Wall Flashing (Self Adhering):

3.4.1. SBS Modified bitumen, self adhering sheet membrane complete with a cross laminated polyethylene film having the following properties:

3.4.1.1. Thickness: 1 mm (40 mils) minimum

3.4.1.2. Film thicknesses 0.225 mm (9.0 mils)

3.4.1.3. Tensile strength (film): 34,500 kPa (500 psi)

3.4.2. Standard of Acceptance: Blueskin TWF by Bakor, or Perm-A-Barrier by Grace Membrane Systems.



## Section 04 21 00 Clay Unit Masonry

1. Provide for:
  - 1.1. Mock-up panel of exterior wall, showing patterns and textures as designed.
  - 1.2. Submission of test reports (brick) certifying compliance of units with specification requirements including data indicating initial rate of absorption.
  - 1.3. Color samples (Brick and mortar).
2. Requirements:
  - 2.1. Exterior joints are concave, unless approved by DPW.
  - 2.2. Interior joint face is struck flush.
  - 2.3. Means of stabilizing, caulking, filling of spaces by others is defined.
3. Detail control joints.
4. Weep hole vents are to be PVC.
5. Details of masonry reinforcement and connectors to be indicated on drawings.
6. Shop drawings required for reinforced masonry.
7. Connectors and Reinforcement to be stainless steel where noted and otherwise shall be galvanized in exterior walls and moist environments.
8. Specify spacing of connectors, ties, and reinforcing.
9. Specify additional reinforcement for seismic requirements and the like, if applicable.
10. Specify bonding and tying.
11. Specify placing and grouting of reinforcement, if applicable.
12. Refer to DC350, Part 1 - Section 1, Article 10 for exterior wall construction requirements.
13. Wall thermal rating in accordance with DC350, Part 1, Section 2 - Division 07.
14. Note and specify appropriate reinforcing to accommodate mechanical fasteners of cavity insulation.
15. Exterior Masonry Walls
  - 15.1. Where exterior wall veneer design incorporates the use of Clay Face Brick, specify products as follows:
    - 15.1.1. To Requirements of CAN/CSA-A82-14.

- 15.1.1.1. Type: FBS
- 15.1.1.2. Grade: SW
- 15.1.1.3. Size: Metric modular, include special shapes as required.
- 15.1.1.4. Colour & Texture: To requirements of the Design Brief.
- 15.1.1.5. Compressive Strength: 55 MPa minimum.
- 15.1.1.6. Absorption (24 hr. cold water): 10% maximum.
- 15.1.1.7. Saturation Co-efficient: 0.78 average.
- 15.1.1.8. Initial Rate of Absorption: 20 gm/min/194cm<sup>2</sup>.
- 15.1.1.9. Freeze Thaw (50 cycles):
  - 15.1.1.9.1. No Breakage
  - 15.1.1.9.2. Not greater than 0.5% loss in dry mass of any individual brick.

## Section 04 22 00 Concrete Unit Masonry

1. When providing Standard Concrete Masonry Units provide to CAN/CSA A165 SERIES-14 and as follows:
  - 1.1. Classification:
    - 1.1.1. Hollow Units: H/15/A/M
    - 1.1.2. Solid Units: S/15/A/M
  - 1.2. Special shapes:
    - 1.2.1. Provide bull-nosed units for all exposed corners and at windowsills, unless specified otherwise.
    - 1.2.2. Provide purpose-made shapes for lintels and bond beams.
    - 1.2.3. Provide other special shapes as required.
    - 1.2.4. reinforcing as per structural engineer instructions.
2. When providing Architectural Concrete Block units, provide to CAN/CSA A165 SERIES-14 and as follows:
  - 2.1. Split faced and two rib split faced block.
  - 2.2. Colour selected by Consultant, in conjunction with the DPW and Client Department.
  - 2.3. Provide special shapes as required.
3. Concrete block units
  - 3.1. Bond: Running
  - 3.2. Coursing height: 200mm for one block and one joint.
  - 3.3. Jointing: concave where exposed or where paint or other finish coating is specified, or as project requirements dictate.
4. Concrete block lintels
  - 4.1. Install reinforced concrete block lintels over openings in masonry, sized to suit openings width with a minimum end bearing of 200 mm. Use steel lintels only where block lintels are not possible.
5. Provide bullnosed concrete block for exposed corners.
6. Acoustical concrete block may be used for noise reduction.

7. Indicate the fire resistance rating to each concrete block unit wall requiring such rating.
8. Concrete block control jointing as decided by Consultant.
9. Exterior walls of Concrete Masonry Units to be insulated cavity walls.

**END**

## DIVISION 05 – METALS

### Section 05 00 00 Metals

#### 1. General

##### 1.1. Welding companies to be certified

1.1.1. :Under Division 1 or 2.1 of CSA W47.1 - Certification of Companies for Fusion Welding of Steel, where such welding is required

1.1.2. Under CSA W55.3 - Certification of Companies for Resistance Welding of Steel and Aluminum, where such welding is required.

1.2. Welding to be done in accordance with CSA W59.

1.3. Structural steel work to be done in accordance with CSA S16 and CSA S136.

1.4. All welded connections are to be designed, and all welding materials and procedures are to be selected and supervised by a Canadian Welding Bureau Welding Engineer in accordance with CSA W59.

1.5. Design shall not include exposed steel structure unless approved by DPW Representative.

##### 1.6. Sustainability

1.6.1. Under Division 1 or 2.1 of CSA W47.1 - Certification of Companies for Fusion Welding of Steel, where such welding is required

1.6.2. Design for future disassembly. Where feasible make possible the removal and future re-use, refurbishing or recycling of steel. Design mechanical connections to be reversible-i.e. using bolted rather than welded connections where feasible. Bolting also eliminates the dangerous fumes and gases associated with welding.

1.6.3. Design Structural systems for efficiency and durability to reduce carbon footprint. Consider future flexibility and adaptability.

##### 1.7. Durability

1.7.1. 1.7.1 Under Division 1 or 2.1 of CSA W47.1 - Certification of Companies for Fusion Welding of Steel, where such welding is required

## Section 05 10 00 Structural Steel for Buildings

### 1. General

- 1.1. Design details and connections in accordance with requirements of CSA S16 to resist moments and shear forces. Allow for movement.
- 1.2. Design all new roofs with structural slope to roof drains. Minimum slope is to be two (2) percent. Confirm with Architect and Structural Engineer that the roof is designed to minimize ponding water, and overflow roof scuppers are provided at the proper height to minimize risk of overloading roof design.

### 2. Material

- 2.1. Structural Steel is provided to requirements of CAN/CSA-G40.20/G40.21, Grade 300W and Grade 350W, Class C or Class H for HSS Sections.
- 2.2. Anchor Bolts are to be provided to requirements of CAN/CSA-G40.20/G40.21, Grade 300W.
- 2.3. Bolts, nuts, and washers are to be provided to requirements of ASTM F3125/F3125M.
- 2.4. Welding Materials are to be provided to requirements of CSA W48 Series and certified by the Canadian Welding Bureau.
- 2.5. Shop paint primer is to be provided to requirements of CISC/CPMA 1-73a.
- 2.6. Hot dip galvanizing, for galvanized steel exposed to outside, is to be provided to CSA G164, minimum zinc coating of 600 g/m<sup>2</sup>.

### 3. Execution

- 3.1. Fabrication of structural steel is to be provided in accordance with CAN/CSA S16, and with the reviewed shop drawings.
- 3.2. Erect structural steel in accordance with CAN/CSA S16, and in accordance to limited design principles.
- 3.3. Provide 1/4" (6 mm) diameter x 9" (225 mm) long hump rods at 16" (450 mm) OC on all faces of each column butting to concrete block partitions.
- 3.4. Shop Painting
  - 3.4.1. For steel not receiving finish paint on-site. Clean, prepare surfaces, and shop prime structural steel in accordance with CSA S16, except where members will be encased in concrete.

- 3.4.2. For steel to receive further finish painting on-site. Clean, prepare surfaces, and shop prime in accordance with CISC/CPMA 2-75, (brush blasted).
- 3.5. Shop Primer to be water based where feasible and to be selected to have minimal off-gassing of volatile organic compounds.
- 3.6. Written approval of Engineer is to be obtained prior to field cutting or altering of structural members.
- 3.7. Members are to be welded with continuous welds, and ground smooth where welding is indicated.
- 3.8. Bolts, rivets, welds, burns and/ or scratched surfaces to be cleaned with a mechanical brush and touched up with shop primer at completion of erection.

## Section 05 21 00 Steel Joist Framing

1. General
  - 1.1. Design steel joist and bridging to carry loads in accordance with CSA S16, CSA S136.
  - 1.2. Design joists and anchorages for uplift forces.
  - 1.3. Limit roof joist deflection due to specified live load to 1/240 of the span.
  - 1.4. Limit floor joist deflection due to specified live load to 1/360 of the span.
2. Materials
  - 2.1. Structural Steel to be provided to CAN/CSA-G40.20/G40.21 and CSA S136.
  - 2.2. Welding Materials to be provided to CSA W59.
  - 2.3. Shop Primer to be provided to CISC/CPMA 1-73a, CISC/CPMA 2-75.
  - 2.4. Shop Painting
    - 2.4.1. For joists not receiving finish painting on-site:
    - 2.4.2. Clean, prepare, and shop prime all surfaces of steel joists to CSA S16, CAN/CGSB 85.100.
    - 2.4.3. Strip paint from bolts, nuts, sharp edges, and corners before prime coat is dry.
  - 2.5. For joists receiving further finish painting on-site:
    - 2.5.1. Clean, prepare, and shop prime all surfaces of steel joists to CISC/CPMA 2-75, (brush blasted).
    - 2.5.2. Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.
  - 2.6. For provision of certification weldments must be inspected and conform to the Canadian Welding Bureau requirements.
3. Execution
  - 3.1. Erect steel joists and bridging as indicated in accordance with CSA S16.
  - 3.2. Complete installation of bridging, and anchorages before placing construction loads on joists.
  - 3.3. Obtain written approval from Engineer prior to field cutting or altering joists, or bridging.
  - 3.4. Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.



## Section 05 30 00 Steel Decking

### 1. General

- 1.1. Where sound control is required in a space use acoustic steel deck. Acoustic steel deck is to be perforated on the vertical face of the flutes and have interlocking side laps.
- 1.2. Design Criteria
  - 1.2.1. Design steel deck using limit states design in accordance with Canadian Sheet Steel Building Institute CSSBI-10M.
  - 1.2.2. Steel deck and connections to carry dead loads, live diaphragm action lateral loads, composite deck action loads, wind uplift, and other loads appropriate to the project.
  - 1.2.3. Deflection under specified live load not to exceed 1/240th of the span, except when gypsum board ceilings are hung directly from the deck, then ensure a live load deflection does not exceed 1/360th of the span.
  - 1.2.4. Where vibration effects are controlled, ensure dynamic characteristics of decking system are designed in accordance with CSA S16, Appendix 'G'.

### 2. Materials

- 2.1. Zinc-iron Alloy ZF coated steel sheet:
  - 2.1.1. The minimum metallic coating designations for steel roof deck not exposed in service to the weather are ZF75 (zinc coating) or Z180 for ASTM A653/A653M materials and AZM150 for ASTM A792/A792M.
  - 2.1.2. The minimum metallic coating designations for steel roof deck exposed to the weather are Z275(zinc coating) or Z180 for ASTM A653/A653M
- 2.2. Where deck is to receive paint, supply wiped or satin coated decking.
- 2.3. Provide acoustic insulation as per Part 1, Section 2, Division 07, 07 20 00 - Thermal Protection.
- 2.4. Provide closures type recommended by Deck manufacturer.
- 2.5. Provide cover plates, cell closures, and flashing. Plates to have a minimum base steel thickness of 0.76 mm. Plates are to have the same type of metallic coating, and thickness as coating material provided for the steel deck.

3. Execution

- 3.1. Design, detail, and fabricate in accordance with CSA S136 and CSSBI 10M.
- 3.2. Do Welding in accordance with CSA W59, except where specified otherwise.
- 3.3. Erect steel deck in accordance with CSA S136 and CSSBI 10M, except as specified otherwise:
  - 3.3.1. Butt ends 1.5 mm to 3 mm gap. Install steel cover plates over gaps wider than 3 mm.
  - 3.3.2. Lap ends 50 mm minimum.
  - 3.3.3. After deck is permanently secured in place, immediately touch up metallic coated top surface with compatible primer where burned by welding.
- 3.4. Prior to concrete placement, ensure steel deck is free of soil, debris, standing water, loose mill scale, and other foreign matter.
- 3.5. Place and support steel reinforcement maintaining covers to reinforcement as indicated.
- 3.6. Closures
  - 3.6.1. Install closures as required. Closures to be effective against weather, thermal and acoustic effects.
  - 3.6.2. For details not indicated, follow manufacturer's printed instructions.
- 3.7. Openings and Areas of Concentrated Loads:
  - 3.7.1. No reinforcement is required for openings cut in deck which are smaller than 150 mm square.
  - 3.7.2. Deck openings to be framed, with any one dimension between 150 mm to 300 mm, as designed by Engineer, except as otherwise indicated.
  - 3.7.3. For deck openings, with any one dimension greater than 300 mm, and for areas of concentrated load, reinforce deck in accordance with Engineer's structural framing details.
- 3.8. Install connections in accordance with CSSBI recommendations as indicated.

## Section 05 50 00 Metal Fabrications

1. General
  - 1.1. Provide angle framing for equipment. Prime, paint, and size to suit equipment.
  - 1.2. Provide metal supports for wood benches. Primed and paint except, in wet areas where they are to be galvanized.
  - 1.3. Provide metal locker supports. Prime and paint.
  - 1.4. Railings are to be designed to meet latest National Building Code's requirements for vertical and horizontal live loading.
2. Materials
  - 2.1. Steel Sections and plates to be provided to CAN/CSA-G40.20/G40.21, Grade 300W, and 350W.
  - 2.2. Steel Pipe is to be provided to ASTM A53/A53M galvanized finish.
  - 2.3. Welding materials to be provided to CSA W59.
  - 2.4. Bolts, and anchor bolts to be provided to ASTM A307.
  - 2.5. Galvanizing to be hot dipped with zinc coating 600 g/m<sup>2</sup> provided to CSA G164.
  - 2.6. Stainless steel tubing to be provided to ASTM A269/A269M, type 302 Commercial Grade.
  - 2.7. Chromium plating on steel to be provided with a plating sequence of 0.009 mm thickness of copper, 0.010 mm thickness of nickel, and 0.0025 mm thickness of chromium.
  - 2.8. Shop coat primer is to be provided to CAN/CGSB 1.40.
  - 2.9. Zinc primer to be zinc rich, ready mix to CAN/CGSB 1.181.
  - 2.10. Grout to be non-shrink, non-metallic, flowable, 24h, 15 MPa, with a minimum pull-out strength of 7.9 MPa.
3. Fabrication
  - 3.1. Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
  - 3.2. Use self-tapping shake-proof flat headed screws on items requiring assembly by screws, or as indicated.
  - 3.3. Where possible, fit and shop assemble work, ready for erection.

- 3.4. Exposed welds to be continuous for length of each joint. File or grind exposed welds smooth and flush.
- 3.5. Railings are to be designed to meet latest National Building Code's requirements for vertical and horizontal live loading.
- 3.6. Channel Frames to be fabricated from steel, sized to suit openings. Weld channels to form continuous frame for jambs, and heads of openings. Size to suit opening.
- 3.7. Provide lateral restraining angles for masonry walls, sized by the Structural Engineer. Prime, paint and finish.
- 3.8. Provide loose lintels for all masonry openings, as sized by the Structural Engineer.
- 3.9. Provide Angle Framing for Equipment, prime painted and sized to suit equipment.
- 3.10. Erection
  - 3.10.1. Welding to be done in accordance with CSA W59 unless specified otherwise.
  - 3.10.2. Companies are to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding, and/or CSA W55.3- for resistance welding.
  - 3.10.3. Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
  - 3.10.4. Make field connections with high tensile bolts to CSA S16, or weld.
  - 3.10.5. Touch-up galvanized surfaces with inorganic zinc rich primer where burned by field welding.
  - 3.10.6. Grout as required.

## Section 05 51 00 Metal Stairs and Ladders

### 1. General

- 1.1. Design metal stair, balustrade and landing construction and connections to Latest Edition Building Code requirements for vertical and horizontal live loads.

### 2. Materials

- 2.1. Steel sections to be provided to CAN/CSA-G40.20/G40.21, Grade 300W.
- 2.2. Steel plate to be provided to CAN/CSA-G40.20/G40.21, Grade 300W.
- 2.3. Steel pipe to be provided to ASTM A53/A53M, standard weight, schedule 40, seamless black.
- 2.4. Steel tubing to be provided to CAN/CSA-G40.20/G40.21, ASTM A500/A500M-18, sizes and dimensions as indicated.
- 2.5. Aluminum bar, rod, wire, and extruded shapes to be provided to CSA HA 5.6351-T6.
- 2.6. Welding materials to be provided to CSA W59.
- 2.7. Bolts to be provided to ASTM A307-14e1.
- 2.8. High strength bolts to be provided to ASTM F3125/F3125M.
- 2.9. Shop Coat Primer to be provided to CAN/CGSB 1.40.
- 2.10. Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes - latest edition.

### 3. Execution

- 3.1. Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings. Make exposed connections of same material, colour and finish as base material on which they occur.
- 3.2. Accurately form connections with exposed faces flush, mitres and joints tight. Make risers of equal height.
- 3.3. Grind or file exposed welds and steel sections smooth.
- 3.4. Shop fabricate stairs in sections as large and complete as practical.
- 3.5. Shop Painting
  - 3.5.1. Clean surfaces in accordance with Steel Structures Painting Council SSPC SP 2 or MPI applicable standards.

- 3.5.2. Apply one coat of shop primer except interior surfaces of pans.
- 3.5.3. Apply two coats of primer in contrasting colours to parts inaccessible after final assembly.
- 3.5.4. Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7 deg. C.
- 3.5.5. Do not paint surfaces to be field welded.
- 3.6. Stair Installation
  - 3.6.1. Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting the stairs to the structure.
  - 3.6.2. Hand items over for casting into concrete or building into masonry to the appropriate trades together with the setting templates.
  - 3.6.3. Do welding work in accordance with CSA W59, unless specified otherwise.
  - 3.6.4. Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

**END**

## **DIVISION 06 WOOD, PLASTICS AND COMPOSITES**

### **Section 06 00 00 Wood, Plastics and Composites - General**

1. Information relates to the Department's technical requirements for Rough and Finish Carpentry, Architectural Woodwork, Structural Plastics and Wood and Plastic Restoration.
2. LEED projects require FSC Chain of Custody Certificate for all applicable materials.
3. Wood Framing
  - 3.1. Wood framing is acceptable for:
    - 3.1.1. Trusses for sloped roofs.
    - 3.1.2. Heavy timber construction
    - 3.1.3. Prefabricated laminated wood post and beam systems with tongue and groove wood decks.
  - 3.2. Wood stud framing systems are not permitted, in whole or in part, for any exterior structural wall system. Receive approval from the DPW project leader, prior to incorporation into design, for such use or where other uses for wood framing is desired.
4. Use of Pressure Treated Wood.
  - 4.1. Pressure treated wood shall be used, only in outdoor applications or where exposed to moisture, such as locations where the wood comes in contact with the ground or as substrate in membrane roofing assemblies.
  - 4.2. Pressure treated wood shall not be used in any application where it will be in contact with human skin.
  - 4.3. Pressure treated wood may be used for the construction of screens for outdoor garbage storage or for other applications, only if approved by TIR in writing prior to incorporation in the design, and provided they are not located where occupants will gather on the site.
5. Extended Warranty
  - 5.1. Warranty to provided which guarantees the Finish Carpentry, Millwork, Custom Cabinetry, and all other Architectural Woodwork for a period of four (4) years extended beyond the expiration of the performance assurance requirements specified in the General Conditions.

## Section 06 10 00 Rough Carpentry

1. Source Quality Control
  - 1.1. Lumber Identification
    - 1.1.1. By grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
  - 1.2. Plywood Identification
    - 1.2.1. By grade mark in accordance with applicable CSA Standard
2. Materials
  - 2.1. Lumber Materials
    - 2.1.1. Spruce, Pine, Fir Species Group Designation, framing lumber and boards in accordance with minimum lumber grades for specific end uses of the latest National Building Code, kiln dried.
    - 2.1.2. Moisture content of lumber at time of building-in shall not exceed 19%.
  - 2.2. Plywood
    - 2.2.1. Douglas Fir Plywood (DFP)
      - 2.2.1.1. To CSA O121-17 standard construction.
    - 2.2.2. Canadian softwood Plywood (CSP):
      - 2.2.2.1. To CSA O151-17 standard construction.
      - 2.2.2.2. For utility use, use unsanded, sheathing grade.
      - 2.2.2.3. For sub-flooring, use T&G unsanded, select sheathing grade.
  - 2.3. Fasteners
    - 2.3.1. Galvanizing
      - 2.3.1.1. To CSA G164-18, use galvanized fasteners for exterior work and high humidity areas.
    - 2.3.2. Nails, spikes and staples
      - 2.3.2.1. To CSA B111-1974 (R2003)
    - 2.3.3. Use Galvanized nails, spikes and staples for:
      - 2.3.3.1. Exterior Work
      - 2.3.3.2. Interior high humidity areas
      - 2.3.3.3. Treated Lumber



- 2.3.3.4. Otherwise use plain finish.
- 2.3.4. Bolts
  - 2.3.4.1. Galvanized unless indicated otherwise, complete with nuts and washers.
- 2.3.5. Propriety Fasteners
  - 2.3.5.1. Toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for the purpose by the manufacturer.
- 2.4. Wood Preservative
  - 2.4.1. Surface Applied Wood Preservative
    - 2.4.1.1. Use coloured, copper naphthenate or 5 % pentachlorophenol solution, water repellent preservative to meet specified requirements of CAN/CSA O80 SERIES-15.
- 2.5. Damp Proof Membrane
  - 2.5.1. Use 6 mil polyethylene film, unless otherwise required.
- 3. Construction
  - 3.1. Comply with the requirements of the latest National Building Code, supplemented by the following.
    - 3.1.1. Nailing Strips, Grounds and Rough Bucks
      - 3.1.1.1. Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work. Install wood blocking in drywall partitions for anchoring items, including but not limited to, counters, vanities, cupboards, blind supports, handrails and grab bars.
    - 3.1.2. Fasteners
      - 3.1.2.1. Frame, anchor, fasten, tie and brace members providing necessary strength and rigidity.
      - 3.1.2.2. Countersink bolts where necessary to provide clearance for other work.
      - 3.1.2.3. Dampproofing
        - 3.1.2.3.1. Install dampproof membrane between wood members and concrete.
      - 3.1.2.4. Ensure bolted fasteners are drawn tightly.

## Section 06 20 00 Finish Carpentry

### 1. Materials

#### 1.1. Moisture content at time of installation

1.1.1. For interior locations: 7%

1.1.2. For exterior locations: 12%

#### 1.2. Use only adhesives and fastenings that develop sufficient strength for intended use, are non-staining, are unaffected by the environment to which exposed and are manufactured to applicable CSA standards.

#### 1.3. Wood:

1.3.1. Grade mark softwood and hardwood lumber by the appropriate association under authority of the National Lumber Grades Authority.

1.3.2. Where not exposed to view, use wood of grades suitable for fabrication, utility and structural needs.

1.3.3. Where exposed to view, use wood to meet requirements of AWMAC Quality Grade Standard.

#### 1.4. Plywood:

##### 1.4.1. Hardwood Plywood:

1.4.1.1. To CSA O115-M1982 (R2001) of species and thickness indicated.

1.4.1.2. Rotary veneer.

1.4.1.3. Use veneer core with Type II bond.

1.4.1.4. Good grade, where exposed to view, sound grade otherwise.

##### 1.4.2. Canadian Softwood Plywood (CSP)

1.4.2.1. To CSA O151-17

1.4.2.2. Sanded exterior grade, good two sides where both sides are exposed to view and good one side where only one side is exposed to view.

##### 1.4.3. Douglas Fir Plywood (DFP)

1.4.3.1. To CSA O121-17.

1.4.3.2. Exterior grade, good two sides where both sides are exposed to view and good one side where only one side is exposed to view.

- 1.4.4. Poplar Plywood
  - 1.4.4.1. To CSA O153-13 (R2017)
- 1.4.5. Composite Materials
  - 1.4.5.1. Particle Board: to NPA A208.1-2009, Grade M3:
    - 1.4.5.1.1. For postformed counter tops: 11/16" thick, 45 lb.cu.ft., built-up edge, front and back.
    - 1.4.5.1.2. For Flat work and other work: medium density, 45 lb.cu.ft.
- 1.5. Adhesives and Sealers: tested for acceptable VOC emissions to meet applicable EcoLogo or MPI Extreme Green certifications or in accordance with ASTM D2832-92(2016) and the applicable ASTM standard for determining the composition of the volatile fraction.
- 1.6. Finishing:
  - 1.6.1. sand edges before finishing.
  - 1.6.2. spray undercoat.
  - 1.6.3. sand (fine paper)
  - 1.6.4. two coats sprayed lacquer, where no other finish is provided, and material is exposed to view.

**Section 06 22 00 Millwork**

1. Materials
  - 1.1. To requirements of Part 1, Section 2, Division 06, item 06 20 00.1 and as follows:
  - 1.2. Where Standing and Running Trim is incorporated into design use Eastern White Pine or Clear Spruce.
2. Construction
  - 2.1. To requirements of Part 1, Section 2, Division 06, item 06 20 00 and as follows.
  - 2.2. Do millwork to Quality Standards of the Architectural Woodwork Manufacturers' Association of Canada.
3. Mock-ups are required for all millwork.

## Section 06 25 00 Pre-finished Paneling

1. Where Architectural Woodwork Paneling is incorporated into design:
  - 1.1. Flush Paneling:
    - 1.1.1. decorative with a transparent finish.
    - 1.1.2. AWMAC Custom grade.
    - 1.1.3. specify matching (veneer pieces and between panels).
  - 1.2. Stile and Rail Paneling:
    - 1.2.1. decorative with a transparent finish.
    - 1.2.2. AWMAC Premium grade.
    - 1.2.3. provide scale elevations, panel mould details, specifications for material species and panel matching.

## Section 06 40 00 Architectural Woodwork

1. Architectural woodwork shall be manufactured and/or installed to current AWMAC Architectural Woodwork Standards, Edition Two (2014) Plus All Errata Through April 29, 2016, and shall be subject to an inspection at the plant and/or site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the tender price for the project.
  - 1.1. Shop drawings shall be submitted to the AWMAC Chapter office for review before work commences. Work that does not meet the AWMAC Architectural Woodwork Standards, Edition Two (2014) Plus All Errata Through April 29, 2016, as specified, shall be replaced, reworked and/or refinished by the architectural woodwork contractor, to the approval of AWMAC, at no additional cost to the owner.
2. Wood Panels and Melamine Component Panels (MCP)
  - 2.1. Material to be manufactured to American Laminators Association Performance Standards and ANSI A208.1-2009, Grade M3 particleboard.
  - 2.2. Construct laminated sandwich of melamine resin impregnated paper thermally fused to a particleboard core.
  - 2.3. Finish Suede; colours chosen by Consultant from manufacturer's full range. No more than 4 colors per job.
  - 2.4. Finish all sides to reduce emissions.
  - 2.5. All MCPs to be edged on exposed or semi-exposed edges with:
    - 2.5.1. Solid high impact, purified colour-thru PVC, 3mm thick, hot machine applied, and automatically trimmed face, back and corners for a uniform appearance.
    - 2.5.2. Acceptable products: Wood-tape, Canplast and Polyplast.
  - 2.6. Adhesives and Sealers: tested for acceptable VOC emissions to meet applicable EcoLogo or MPI Extreme Green certifications or in accordance with ASTM D2832-92(2016) and the applicable ASTM standard for determining the composition of the volatile fraction.
  - 2.7. Construction of Wood Material Cabinetry
    - 2.7.1. Fasten work with nails generally, but use screws or special fasteners at critical joints, and where required by specified quality grade standards.
    - 2.7.2. Glue built-up work, as well as nailing or screwing.
    - 2.7.3. Blind nail where practical.

- 2.7.4. Set finishing nails below finished surfaces receiving filler.
- 2.7.5. Ensure each surface of Work, where exposed or semi-exposed, is finished appropriately.
- 2.7.6. 3mm hardwood edge on exposed and semi-exposed edges of plywood construction cupboards. Hot machine applied and automatically trimmed face, back and corners for a uniform appearance.
- 2.7.7. Fine sand exposed surfaces level and smooth after fabrication.
- 2.7.8. Construct cabinetry sections that are square, plumb and true.
- 2.8. Construction of Melamine Composite Cabinetry
  - 2.8.1. Drawer fronts to be the same color as doors; securely fastened to drawer box unit.
  - 2.8.2. Exposed or semi-exposed edges to be covered with 3 mm PVC, as identified above for MCPs, radiused and rounded on all doors and drawer fronts, or sealed where not exposed.
  - 2.8.3. Toekicks to be 3/4" Douglas fir plywood.
  - 2.8.4. Any required wood members to be hardwood.
  - 2.8.5. Wooden dowels at all glued connections.
  - 2.8.6. Plastic anchor inserts or bolt through construction for all hardware.
  - 2.8.7. Bolt through connection for side-to-side connections.
  - 2.8.8. Shop fabricated pre-finished cupboard sections that are self supporting, square, plumb and true.
- 3. LEED projects require FSC Chain of Custody Certificate FSC-STD-40-004 (V3-0).

## Section 06 41 00 Architectural Wood Casework

### 1. Custom Cabinets

1.1. Mock-ups are required of all casework.

#### 1.2. Materials

1.2.1. To requirements of Part 1, Section 2, Division 06, item 06 20 00, 06 40 00 and as follows.

1.2.2. Construct cabinets of either solid wood (plywood), Medium Density Fibreboard (MDF) or Melamine Composite Panels (MCP). Other materials will not be acceptable unless approved in writing by DPW.

1.2.3. Refer to PART 2, Section 2 for client specific requirements regarding acceptable materials.

#### 1.3. Construction of Plastic Laminate-Clad Architectural Cabinets

1.3.1. To requirements of Part 1, Section 2, Division 06, item 06 20 00, 06 40 00 and as follows.

1.3.2. Do millwork to Custom Quality Standards of the Architectural Woodwork Manufacturers' Association of Canada.

1.3.3. For case bodies, shelving, doors, drawer fronts; plywood, MDF or MCP are accepted unless noted otherwise.

##### 1.3.4. Case Construction:

1.3.4.1. bodies, ends, divisions and bottoms not less than 3/4" thick.

1.3.4.2. shelves up to 36" wide, 3/4" thick.

1.3.4.3. shelves greater than 36", up to 42" wide, 1" thick.

1.3.4.4. no shelves over 42" unsupported.

1.3.4.5. backs min. 1/4" thick and may be of plywood or tempered hardboard.

1.3.4.6. adjustable shelves supported by flush set metal standards.

##### 1.3.5. Drawers:

1.3.5.1. Provide metal guides.

##### 1.3.6. Doors:

1.3.6.1. Provide flush with eased edges.

##### 1.3.7. Hardware:



- 1.3.7.1. concealed, self-closing hinges 110<sup>o</sup> opening.
  - 1.3.7.2. drawer slides - captive guide rail, side mounted, heavy duty, steel, minimum capacity 150 lbs per pair.
  - 1.3.7.3. pulls back mounted, 4" long rod type.
  - 1.3.7.4. locks half mortised into back.
  - 1.3.7.5. schedule hardware by cabinet groups.
  - 1.3.7.6. specify bumpers on doors.
- 1.4. Finishing:
- 1.4.1. sand edges before finishing.
  - 1.4.2. spray undercoat.
  - 1.4.3. sand (fine paper)
  - 1.4.4. two coats sprayed lacquer, where no other finish is provided and material is exposed to view.
2. Refer to 12 36 00 for Countertops and Back splash requirements.

**Section 06 46 00 Wood Trim**

1. Where Architectural Woodwork Standing and Running Trim is incorporated into design use Eastern White Pine or Clear Spruce.
2. Ensure warranty is provided which guarantees the millwork for a period of four (4) years beyond the date of performance assurance.

**END**

## DIVISION 07 - THERMAL AND MOISTURE PROTECTION

### Section 07 00 00 General

1. Information relates to the Department's technical requirements regarding damp-proofing and waterproofing, thermal protection, shingles and roof coverings, roofing and siding panels, membrane roofing, flashing and sheet metal, roof specialties and accessories, fire and smoke protection, joint sealers, and the like.
2. Building Envelope
  - 2.1. Provide building envelopes that effectively and efficiently separate the interior from the exterior environment by controlling the movement of air (not more than 0.1 L/S per m<sup>2</sup> at 75 Pa.), water, heat, and water vapour using assemblies that are practical, constructable, and economical while minimizing operating and maintenance life cycle costs.
  - 2.2. Refer to DC350, Part 1, Section 1, Item 9 - Building Envelope Assemblies regarding design and detail of the building envelope.
  - 2.3. Design building envelope to eliminate thermal bridging and condensation
3. Extended Warranty: Unless otherwise specified herein:
  - 3.1. Project manual to specify requirements of manufacturer's warranty against manufacturer's defects on all roofing membrane materials for a period of nine (9) years beyond the date of expiration of performance assurance.
  - 3.2. Project manual to specify requirement of a contractor's warranty extending the warranty for all roofing labour and workmanship for a period of one (1) year beyond the date of expiration of performance assurance requirements specified in the General Conditions.
  - 3.3. Project manual to specify requirement for extended warranty, from the roofing contractor, for defects in materials and workmanship of the sheet metal work incorporated into design. Warranty to cover a period of 1 year beyond the expiration of the performance assurance requirements specified in the General Conditions.
  - 3.4. Make provision in the project manual for extended warranty, from the roof coating manufacturer addressed to the Minister, where roof coating is incorporated into design. Warranty to cover defects in manufacturing for a period of five (5) years beyond the date of expiration of performance assurance requirements specified in the General Conditions. Longer periods may be required. Discuss requirements with DPW.

- 3.5. Replacement shall include, where applicable, removal of all defective roof assembly materials, installation of new roofing assembly in affected area, and repair and making good of displaced and adjacent Work damaged during replacement. As a minimum, indicate defective work will include, but not be limited to, leaking, wind uplift, delamination of roofing material, reduction of thermal value due to moisture in insulation, crazing, or ridging.
- 3.6. Extended Warranties shall be non-prorated.
4. Overburden Extended Warranty for green roofs
  - 4.1. Project manual to specify the requirement for a ten (10) year overburden extended warranty from the Roofing manufacturer which covers the removal, roof repair and replacement of all roofing components above the membrane, including protection fabric, polystyrene, drainage products, moisture retention mat, growth media, and roof garden plants in the event of a leak.
5. Roofing
  - 5.1. Quality Assurance
    - 5.1.1. Consultant shall incorporate roofing details into the design ensuring the finished roof meets or exceeds the CSA A123.21-14 wind uplift load standards and the requirements of CRCA, unless specified otherwise. Design for a higher FM wind uplift where required by regional climatic data.
    - 5.1.2. The roof design must meet a Class A, B or C Rating as required by occupancy and size and defined in ULC 107-10 "Method of Fire Test of Roof Coverings." Proof of this compliance must be provided.
    - 5.1.3. A start-up meeting will be held with the roof membrane manufacturer's representative and inspection reports will be provided during installation.
    - 5.1.4. Roofing system must be applied by a roofing contractor authorized by the roofing manufacturer to meet all warranty requirements.
    - 5.1.5. Upon completion of the installation, an inspection shall be made by a representative of the roofing manufacturer to ascertain that the roofing system has been installed according to required specifications and details. Manufacturer's representative shall provide a written final inspection report.
  - 5.2. Roofing
    - 5.2.1. All penetrations to be carefully detailed and components identified.
    - 5.2.2. At roof and wall junctions, ensure the roof membrane is extended a minimum of 300 mm up walls. Ensure the wall's construction

- sequence does not interfere with the continuous operation of the roofing work.
- 5.2.3. Roofing surfaces, including parapets, to be sloped to drain. Design the drainage to promote the rapid removal of water.
  - 5.2.4. Slope all roof surfaces to drain at a low point. Level valleys are not acceptable. Minimum slope required is 2%. Form the slopes in the structure. Do not use insulating fill or insulation to obtain slopes except for:
    - 5.2.4.1. Re-roofing
    - 5.2.4.2. Augmentation of sloped structural systems, such as at crickets.
  - 5.2.5. Metal deck to be covered by a non-paper backed exterior grade drywall, or rigid mineral wool insulation board with actual density of 11 lb/ft<sup>3</sup> top surface coated with bitumen, before installation of a vapour barrier.
  - 5.2.6. Generally maintain the same elevation around the perimeter of roof. If roof edge is sloped, detail the extreme conditions at the high and low points of the slope.
  - 5.2.7. Slope flashing surfaces minimum 1:6.
  - 5.2.8. All metal roofing and counter flashing elements are to be considered only as water shedding elements below which a waterproofing membrane is required. Do not design metal flashing (except sheet lead) to be part of the waterproofing system.
  - 5.2.9. Provide open flow roof drains with strainer domes. Provide minimum number of drains for each roof area designed to take into account expected loading conditions. Designed roof to maintain required slope. Incorporate roof dividers into design where required to maintain slope and drainage requirements.
  - 5.2.10. Raise all penetrations and perimeters of the roofing membrane above 300mm adjacent roofing membrane level. See Section 07 70 00. Discuss with DPW for exceptions, and design details.
  - 5.2.11. Provide access to roofs.
  - 5.2.12. In all roof assemblies, ensure uppermost face of rigid insulation is protected by an application of at least 1 layer of protective cover board with a minimum thickness of 12.7 mm; and when using expanded or extruded polystyrene insulation, 2 layers of protective

cover board each 12.7mm thick, staggered with joints off set from main insulation board joints.

5.2.13. Use the ballasted, protected membrane roofing system only when permitted by DPW. Section 07 53 00.2 says that ballasted and IRMA not allowed. Use precast slabs as the ballast and protective surfacing in required locations.

5.2.14. Where required by code specify a material with the required fire resistance rating, but having a minimum thickness not less than 12.7 mm.

## 6. Adhesives

6.1. All adhesives to meet emission and toxicity standards published by Environment Canada (Ecologo labels) and CSA.

6.2. Adhesives for cold-applied roofing products to CAN/CGSB 37.

## 7. Storage and Handling of Roofing Materials

7.1. Store all roll material in an upright position in a dry location with temperature maintained within manufacturers' recommended tolerances. Use materials in roof construction within 4 hours of removal from storage.

7.2. Keep all roofing material and adhesives away from ignition sources.

7.3. Roll out and allow material to relax a minimum of 30 minutes before installation, or to manufacturer's instructions.

7.4. Consult all container labels, Material Safety Data Sheets, and technical information for safety information specific to the products used.

7.5. Use roof system products from the same manufacturer and do not use materials or methods which will invalidate manufacturer's warranty.

7.6. Measures to be specified and followed to prevent intake of adhesives or other construction odours from the roof construction into occupied areas through rooftop air intake units.

## 8. Roofing over existing roof surfaces (re-roofing)

8.1. Storage and handling of roll roofing materials, as above in Section 07 00 00.6.

### 8.2. Installation

8.2.1. Confirm the structural capacity of the existing roof to bear the added weight of new roof components and construction activities

8.2.2. Specify repair or replacement of unsuitable areas

- 8.2.3. Confirm that components (chemical or material) of existing roof assembly are not incompatible or detrimental to the new roofing materials.
- 8.2.4. Confirm that the height, profile and clearances of existing parapets, scuppers, penetrations, curbs, as well as high wall to low roof flashing, cladding, door sills and windowsills are sufficient to accommodate new roofing requirements.
- 8.2.5. The substrate of the existing roof should be structurally sound, smooth, flat, clean, dry, free of splinters and sharp edges. Ballast should be removed to a smooth surface.
- 8.2.6. Adequate measures to be taken to investigate the existing roof system for excess moisture build-up.
- 8.2.7. If moist areas are discovered, specify remedial action to be taken before new re-roofing work begins.
- 8.2.8. Follow manufacturer's recommendations regarding primer, vapour barriers, rigid insulation and/or protective cover board material to be placed over the existing prepared substrate.
- 8.2.9. Follow manufacturer's recommendations for multiple-ply or single-ply re-roofing.
- 8.2.10. Provide an additional layer of membrane beneath traffic pavers and mount pavers as recommended by manufacturer.
- 8.2.11. Protect finished sections of roof from later construction activities.

## Section 07 10 00 Damp-proofing and Waterproofing

1. Waterproofing, Extended Warranty:
  - 1.1. Project manual to specify requirement of a system warranty for all waterproofing for a period of one (1) year beyond the date of expiration of performance assurance requirements specified in the General Conditions.
  - 1.2. Replacement shall include, where applicable, removal of covering materials, reinstating them in new condition, repair and making good of displaced and adjacent Work damaged during replacement, as well as, replacement of the waterproofing material. As a minimum, definition of defective work will include, but not be limited to, leaking where water enters the building through faults in the waterproofing materials or in their bond to waterproofed surfaces.
2. Materials
  - 2.1. Sheet waterproofing
    - 2.1.1. Asphalt
      - 2.1.1.1. To requirements of CAN/CGSB 37.2-M88 for application and curing at temperatures recommended by manufacturers.
      - 2.1.1.2. To requirements of CGSB 37-GP-9MA for application and curing at temperatures recommended by manufacturers.
    - 2.1.2. Asphalt Primer
      - 2.1.2.1. To CGSB 37-GP-2M and CGSB 37-GP-9MA, as applicable
    - 2.1.3. Reinforcing Fabric
      - 2.1.3.1. To CGSB 37-GP-63M synthetic resin or asphalt bonded type.
    - 2.1.4. Sealing Compound
      - 2.1.4.1. Rubber Asphalt to CAN/CGSB 37.29-M89
    - 2.1.5. Protection Board
      - 2.1.5.1. See DC-350, Part 1, Section 2, Division 7, 07 20 00 - Thermal Protection; Protective Coverboard
  - 2.2. Elastomeric Roof Coating
    - 2.2.1. Where an elastomeric roof coating is incorporated into the design, refer to latest edition of NMS document Section 07 18 00 - Traffic Coatings as appropriate to the project.



- 2.2.2. Make provision for quality control of coating application by specifying work be executed by a firm of specialists in the type of work, and who are acceptable to, and trained by, the roofing material manufacturer. Additionally, make provision that roofing material manufacturer's representative approve, by on-site visits, means and methods carried out by roofing contractor.

## Section 07 20 00 Thermal Protection

### 1. General

- 1.1. CFC free.
- 1.2. Provide insulation to completely enclose the building envelope structure.
- 1.3. Place the warm side of the insulation in direct contact with the air/vapour barrier.
- 1.4. Incorporate perimeter foundation insulation into design
  - 1.4.1. Insulation to a depth of 600mm below bottom of finish grade on inside face of perimeter foundation walls.
  - 1.4.2. Insulation to 600mm in from perimeter foundation wall under slabs on grade.
  - 1.4.3. Where in-floor radiant heating is specified ensure floor slab is fully insulated to meet requirements of heating system. Coordinate with Mechanical.
  - 1.4.4. Ensure foundation insulation is R- value 10 aged 5 years expanded polystyrene type 2 or extruded polystyrene type 4.
- 1.5. Where cavity wall insulation is incorporated into design:
  - 1.5.1. Provide polystyrene, R Value 15 aged 5 years to meet CAN/ULC S770-15 Standard Test Method.
  - 1.5.2. Ensure insulation held in place by mechanical fasteners (Wedge-Lok type) at 400mm x 400mm.
- 1.6. Where tapered roofing insulation is incorporated into design:
  - 1.6.1. Make provision for custom designed tapered insulation providing a slope of 2%. Taper insulation to drain, ensuring an average R-30 is maintained and minimums as stated below.
- 1.7. Insulation Value
  - 1.7.1. Acceptable values for insulation thermal resistance per inch:
    - 1.7.1.1. Are those specified in the National Research Council's NRC-CNRC Registry of Product Evaluations (latest edition) and all current published amendments.
    - 1.7.1.2. Provide, to DPW representative, verification of the NRC evaluation listings of wall and roof insulations used on the project.

1.7.2. Polystyrene Insulation:

1.7.2.1. Where polystyrene is incorporated, for most roofing projects, Type 1 CAN/ULC S701-11 meets requirements for compressive strength. Review such need prior to specifying in Project Manual.

1.7.3. Polyisocyanurate Insulation

1.7.3.1. To CAN/ULC S704-11

1.7.3.2. Where polyisocyanurate insulation is incorporated, the acceptable thermal resistance values per inch of thickness is R5.56 per one inch thickness.

1.7.4. Ensure provision, except where noted otherwise, of the following minimum R-values:

1.7.4.1. For Walls, including Cavity Walls, R15

1.7.4.2. For Roofs, average R30

1.7.4.3. For Interior face of Foundation Walls and under slabs on grade R10

1.7.4.4. R values listed in the DC350 are provided as a guideline and minimum requirement only. It remains the responsibility of the consultant to design the envelope, including insulation values to meet the current Nova Scotia Climate Change Action Plan and LEED performance requirements.

1.7.5. Provide a flame spread rating of less than 25 for Cavity wall insulation.

1.7.6. Ensure the Contractor provides verification of the NRC evaluation listings from the manufacturer of the specific wall and roof insulations used on the project.

2. Materials

2.1. Protective Coverboard:

2.1.1. In Roofing Applications

2.1.1.1. Over rigid roof insulation, and prior to roof membrane installation, provide a protective coverboard. 1 layer minimum thickness 12.7mm, fully adhered or mechanically fastened to deck. Thickness to meet applicable manufacturer's recommendations for warranty requirements. Where 2 layers required, stagger joints between each layer by half panel.

- 2.1.1.2. Mechanically fastened design to be detailed to include fastener pattern to meet CSA A123.21-14 screws and plates approval. Screws and plate to meet ULC label, where required by code.
- 2.1.1.3. Rigid 1" mineral wool insulation board CAN/CGSB 51.31-M84 (Thermal Insulation, Mineral Fibre Board for Above Roof Decks) actual density of 11 lb/ft<sup>3</sup> top surface coated with bitumen.
- 2.2. Acoustic Insulation for Steel Decks:
  - 2.2.1. Fibrous glass insulation, 15.5 kg/m<sup>3</sup> density profiled to suit deck flutes.
- 2.3. Batt Insulation
  - 2.3.1. Glass Fibre Batts: To meet CAN/ULC-S702-14, Type IA
  - 2.3.2. Mineral Wool Batts: To ASTM C612-14, Class 1
- 3. Installation
  - 3.1. Batt Insulation Installation
    - 3.1.1. Ensure insulation is supported to prevent settlement.
    - 3.1.2. Install friction fit batts snugly between framing members.
    - 3.1.3. Fit batt insulation snugly and without compression into every void to ensure full thickness for full length of construction.
    - 3.1.4. Install to meet ASTM C1320-10(2016).
  - 3.2. Cavity Wall Insulation Installation
    - 3.2.1. Secure cavity wall insulation to substrate by wedging fasteners between masonry ties and insulation.
  - 3.3. Adhesive installation of Insulation on Foundation Walls
    - 3.3.1. Secure installation by adhesive.
    - 3.3.2. Prime surfaces before application of adhesive as recommended by adhesive manufacturer.
    - 3.3.3. Position and press boards into full contact with adhesive, and temporarily hold them in place until adhesive has set.
    - 3.3.4. Ensure that backfilling is completed with 24 hours, and that it does not dislodge or damage insulation.

3.4. Insulation for Precast Architectural Concrete

3.4.1. Where steel stud back-up walls are required in the design for Precast Architectural Concrete, refer to DC350, Part 1, Section 2:

3.4.1.1. Division 03 for Precast Architectural Concrete

3.4.1.2. Division 07 for Vapour Barrier

3.4.1.3. Division 09, for stud back-up

3.4.1.4. Ensure assembly design provides for a minimum 25mm rigid, ship lapped edged, polystyrene insulated sheathing on the exterior and fibreglass batt insulation between the studs.

**Section 07 24 00 Exterior Insulation and Finish System (EIFS)**

1. Cement board with synthetic stucco finish at wall locations higher than 12 feet above finished grade is an acceptable material for exterior walls.
2. Where the system forms part of a cavity wall system, ensure exterior wall design utilizes the “rain screen” principle.

## Section 07 25 00 Weather Barriers / Vapour Retarders / Air Barriers

1. Materials, include but are not limited to:
  - 1.1. Sheet Vapour Barrier
    - 1.1.1. Polyethylene Film, to CAN/CGSB 51.34-M86, 6 mil thick.
  - 1.2. Membrane Air Barrier & Flexible Membrane Flashing
    - 1.2.1. SBS modified bituminous air barrier membrane, minimum 40 mil thick.
    - 1.2.2. Brick ties and other penetrations should be sealed with mastic.
  - 1.3. Cold Applied Roofing System Vapour Barriers
    - 1.3.1. Self-adhesive, modified bitumen vapour barrier, minimum 95 gram
2. Air barriers are to resist air pressure differences of not more than 0.1 L/S per m<sup>2</sup> at 75 Pa.
3. Place air/vapour barrier on the warm side of the insulation.
4. Air barrier to be capable of maintaining its continuity and contact with the insulation under all expected loading conditions.
5. Prepare large scale details to show how air barrier continuity is maintained at window surrounds, roof and wall junctions, envelope penetrations and changes of substrate materials.
6. Clearly define the roles and procedures for the installation of the air barrier amongst the various trades. Drawings to contain specific reference to the air barrier element in each section of the envelope.
7. Design to incorporate vapour barrier such that moisture in the wall is on the cold side of the vapour barrier and that the moisture can dissipate to the outside atmosphere.
8. Sheet Vapour Barrier Installation
  - 8.1. Install sheet vapour barrier on warm side of exterior wall and ceiling assemblies prior to installation of gypsum board to form continuous barrier.
  - 8.2. Use sheets of largest practical size to minimize joints.
  - 8.3. Inspect sheet for continuity. Repair punctures and tears with sealing tape before work is concealed.
  - 8.4. Exterior Surface Openings
    - 8.4.1. Cut sheet vapour barrier to form openings and ensure material is lapped and sealed to door and window frames.

- 8.4.2. Lap and seal air barrier membrane over vapour barrier at openings to provide continuity.
- 8.5. Perimeter Seals
  - 8.5.1. Seal perimeter of sheet vapour barrier as follows
    - 8.5.1.1. Apply continuous bead of sealant to substrate at perimeter of sheets.
    - 8.5.1.2. Lap sheet over sealant and press into sealant bead.
    - 8.5.1.3. No gaps to exist in the sealant bead. Smooth out folds and ripples occurring in the sheet over the sealant.
- 8.6. Lap Joint Seals
  - 8.6.1. Seal lap joints of sheet vapour barrier as follows:
    - 8.6.1.1. Attach first sheet to substrate.
    - 8.6.1.2. Apply continuous bead of sealant over solid backing at joint.
    - 8.6.1.3. Lap adjoining sheet minimum 150 mm and press into sealant bead.
    - 8.6.1.4. Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring over sealant.
- 8.7. Penetrations
  - 8.7.1. Seal vapour barrier penetrations, including electrical switches and outlet device boxes as follows:
    - 8.7.1.1. For sheet type vapour barriers, install purpose-made molded box vapour barrier.
    - 8.7.1.2. Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box.
    - 8.7.1.3. Prime all surfaces for adhesion as recommended by manufacturer.
- 9. Air Barrier Installation
  - 9.1. Apply air barrier membrane to the exterior surface of concrete block, plywood, exterior grade drywall, and continuous across changes in substrate materials (i.e. Block to steel, block to plywood, window and door openings.)
  - 9.2. Roll completely after each sheet is applied.
  - 9.3. Apply in strict accordance with manufacturer's printed instructions.
  - 9.4. Prime substrate as per manufacturer's recommendations for the intended application.



- 9.5. Side laps to be a minimum of 50 mm and end laps are a minimum of 150 mm.
- 9.6. Maintain continuity of the air barrier from walls to the roof as indicated.
- 9.7. Lap air barrier with vapour barrier at all window and door openings, in accordance with CSA A440.4:19 rain screen methods.
- 9.8. Connect air barrier to window frames and door frames to provide air tight seals.
  - 9.8.1. Line the head, sill and jambs of the window rough opening with 19mm plywood to run from the line of wall air /vapour barrier to the inside face of the wall.
  - 9.8.2. Apply self adhesive /air vapour barrier, minimum 40mil thick, to full width of the plywood and lap membrane onto the wall air vapour barrier.
  - 9.8.3. Install the window as per CSA A440.4 and the manufacturer's printed instructions.
  - 9.8.4. Apply self adhesive membrane to seal from the back side of the frame to the membrane installed on the plywood. Membrane must have a minimum 12mm contact onto window frame metal and a contact width on the rough opening membrane of at least 38 mm.
  - 9.8.5. Membrane must be carefully fitted at corners so there are no pin holes.
  - 9.8.6. Secure the membrane seal with continuous aluminum angle which covers the full width of membrane contact on the frame and rough opening. Thickness of metal in the angle to be 2mm. Secure the aluminum angle with screws at 200mm c/c in both legs.
  - 9.8.7. Spray foam insulate the space between the frame and the rough opening from the exterior.
  - 9.8.8. Install an exterior break metal sill to fit in under the metal sill of the window frame. Return the front edge of the sill a minimum of 50mm down the face of the wall and secure with a continuous cleat.
  - 9.8.9. Carefully caulk the space between the frame and the building opening and between the frame and the metal sill.
- 9.9. Proper detailing of any areas which do not allow for easy installation of the sheet membrane.
- 9.10. Continuity of air barrier to be achieved by lapping spray-on and roll-on membrane air barriers.

- 9.11. Use air barrier membrane for flexible through wall flashing in masonry walls and where indicated.
  - 9.11.1. Masonry Thru Wall Flashing (Self Adhering): SBS Modified bitumen, self adhering sheet membrane complete with a cross laminated polyethylene film having the following properties:
    - 9.11.1.1. Thickness: 1mm (40 mils) minimum
    - 9.11.1.2. Film thickness 0.225 mm (9.0 mils)
    - 9.11.1.3. Tensile strength (film): 34,500 kPa (500 psi)
  - 9.11.2. Standard of Acceptance: Blueskin TWF by Bakor, or Perm-A-Barrier by Grace Membrane Systems.
- 10. Vapour for Precast Architectural Concrete
  - 10.1. Where steel stud back-up walls are required in the design for Precast Architectural Concrete, refer to DC350, Part 1, Section 2,:
    - 10.1.1. Division 03 for Precast Architectural Concrete
    - 10.1.2. Division 07 for Insulation
    - 10.1.3. Division 09, for stud back-up
    - 10.1.4. Ensure assembly design provides for a 6mil polyethylene vapour barrier.
- 11. Design and locate air/vapour barrier for overhangs and hidden spaces in envelope so that condensation will not occur in these spaces. Consider air/vapour barrier continuity and build- ability, insulation location, thermal bridging and air circulation in order to determine if space will perform better as cold exterior or warm interior space.

**Section 07 30 00 Steep Slope Roofing (Shingles, Roof Tiles, and Roof Coverings)**

1. When the Department expresses its preference to use a modified bitumen roofing membrane on a specific project and the Consultant wishes to propose use of an Asphalt Shingle Roofing System, be prepared to demonstrate such use meets or exceeds the requirements for the modified bitumen system.
2. Specify shingles having a 30-year warranty.
3. Eave protection membrane to extend a minimum of 900mm, measured horizontally, beyond inside face of exterior walls.
4. Provide ice and water protection membrane on roof valleys a minimum dimension of 900mm both sides.

## Section 07 40 00 Roofing and Siding Panels

1. Preformed Metal Cladding/Siding
  - 1.1. Metal cladding panels and metal siding (minimum 24 gauge) for walls higher than 4m above finished grade are acceptable materials for exterior walls. Should such cladding be proposed, demonstrate that these systems meet or exceed requirements of the specified masonry system.
2. Discuss use of metal cladding lower than 4m above ground level with the DPW project leader. Receive DPW approval prior to incorporation into the design.
3. Control snow and ice from sloped roofs.

## Section 07 51 00 Four Ply Built Up Roofing (BUR)

### 1. Materials

- 1.1 Drywall: ½" Exterior grade non paper backed utility board, or rigid 1" mineral wool insulation board CAN/CGSB 51.31-M84, actual density of 11 lb/ft<sup>3</sup> top surface coated with bitumen.
- 1.2 Asphalt Primer: To CGSB 37
- 1.3 Asphalt: Type II and Type III in compliance with CSA A123.
- 1.4 Asphalt Felts: No. 15 perforated asphalt felts or Type IV fibreglass felts.
- 1.5 Insulation: To Part 1, Section 2, Division 07, item 07 20 00 Thermal Protection.
- 1.6 Protective Coverboard
  - 1.6.1 To Part 1, Section 2, Division 07, item 07 20 00 Thermal Protection.
  - 1.6.2 Fire rated boards to be incorporated as required to meet code requirements.
- 1.7 Modified Bituminous Flashing
  - 1.7.1 Base Flashing
    - 1.7.1.1 Non-woven polyester reinforcement with thermofusible elastomeric asphalt.
  - 1.7.2 Cap Flashing
    - 1.7.2.1 Modified Bitumen membrane
      - 1.7.2.1.1 Underside: thermofused plastic film
      - 1.7.2.1.2 Top face: coloured granules
- 2. Where Built-up Bituminous Roofing is incorporated into design:
  - 2.1 Provide 4 ply felts to CRCA standards c/w thermal barrier, vapour barrier, insulation, pea gravel, top covering and modified bituminous flashing
    - 2.1.1 Apply such that application meets or exceeds CSA A123.21-14 wind uplift requirements. Design for a higher FM wind uplift where required.
    - 2.1.2 If mechanically fastened in areas of exposed ceiling, fasteners within flutes to be cut to 25mm and capped.
    - 2.1.3 Provide design details of Modified Bitumen Flashing.
  - 2.2 Where roofing is applied over metal deck, provide exterior grade drywall on metal deck prior to vapour barrier installation.

## Section 07 52 00 Modified Bituminous Membrane Roofing

1. When membrane is torch applied, make provision that the contractor maintains a fire watch for 1 hour after each days roofing operations cease, and that heat sensor unit is used to detect hot spots.
2. Make provision for quality control of membrane application by specifying work be executed by a firm of specialists in the type of work, and who are acceptable to, and trained by, the roofing material manufacturer. Additionally, make provision that roofing material manufacturer's representative approve, by on-site visits, means and methods carried out by roofing contractor.
3. Materials:
  - 3.1. Base Sheet
    - 3.1.1. Reinforcement: non-woven polyester 180 g/M<sup>2</sup>
    - 3.1.2. Elastomeric asphalt: mix of selected bitumen and SBS thermoplastic polymer.
    - 3.1.3. Minimum thickness 2mm.
  - 3.2. Base Flashing:
    - 3.2.1. Have a non-woven polyester reinforcement and SBS thermofusible elastomeric asphalt.
    - 3.2.2. Reinforcement: non-woven polyester, 180 g\M<sup>2</sup>.
    - 3.2.3. Thermofusible elastomeric asphalt: mix of selected bitumen and SBS thermoplastic polymer.
    - 3.2.4. Minimum thickness 2.8 mm.
  - 3.3. Cap Sheet and Cap Sheet Flashing.
    - 3.3.1. Shall have a non-woven polyester reinforcement and SBS thermofusible elastomeric asphalt.
    - 3.3.2. Reinforcement: 250 g\M<sup>2</sup> of non-woven polyester.
    - 3.3.3. Elastomeric asphalt: mix of selected bitumen and SBS thermoplastic polymer.
    - 3.3.4. Minimum thickness 3.8 mm.
    - 3.3.5. combined thickness of base sheet and cap sheet must be a minimum of 6mm.
    - 3.3.6. Cap face protection: ceramic granules, colour from Manufacturer's standard selection.

- 3.4. Expansion joint membrane:
  - 3.4.1. Elastomeric modified bitumen waterproofing membrane.
  - 3.4.2. Reinforcing: polyester tissue.
  - 3.4.3. Minimum thickness 3.8 mm.
  - 3.4.4. Minimum width 500mm.
4. Provide membrane complete with thermal separator, vapour barrier and insulation.
5. Provide a second layer of protective board or cap sheet and mount pavers around roof top units as a walkway.
6. Apply such that application meets or exceeds minimum CSA A123.21-14 wind uplift requirements. Use higher FM wind uplift requirements where required by regional climatic data.
7. If mechanically fastened or fully adhered in areas of exposed ceiling, fasteners between flutes of deck to be cut to 25mm and capped.
8. Detail flashing and counter flashing.
9. Vapour barrier of 2 ply felt and asphalt. Refer to Part 1 Section 2, 07 25 00 Weather Barriers /Vapour Retarders / Air Barriers.
10. Co-ordinate insulation placement to acoustic deck, where acoustic deck is incorporated into design.
11. Where roofing is applied over metal deck, provide exterior grade non-paper backed drywall or rigid 1" mineral wool insulation board CAN/CGSB 51.31-M84 actual density of 11 lbs/cuft top surface coated with bitumen on metal deck prior to vapour barrier installation.
12. Use tape guard, with a minimum 75 mm overlap, at roof penetrations and curbs to ensure torch flame does not reach combustible surfaces.
13. Multiple-ply cold applied modified bitumen roofing
  - 13.1. Standard of Acceptance:
    - 13.1.1. IKO "Modiflex 180 FS" system, base and cap, w/ adhesive to ASTM D3019/D3019M-17, Type III or CGSB 37-GP-14M
    - 13.1.2. Bakor "SA Cap Modified Plus" cap, "Bluebase" base, w/ adhesive Thermostik 840- 10
    - 13.1.3. Tremco "Burmastic" Cold Built-up Roof System with multiple layers of membrane (Ply sheets, PowerPly Base Plies, and PowerPly MB Cap sheet w/ SF BURmastic adhesive.

- 13.1.4. Approved alternative: Alternatives may be proposed by the consultant and subsequently approved following a comparative review of performance characteristics.
- 13.2. Warranties to meet the requirements of Section 07 00 00.3, DC350, current edition.
- 13.3. Installation
  - 13.3.1. Follow manufacturer's instructions regarding use of vapour barrier, primer, base sheet material, and rigid insulation as appropriate to the roof deck construction.
  - 13.3.2. Surface to be clean and dry and free of all ice, water, and debris.
  - 13.3.3. Install only when air temperature is within manufacturer's recommended tolerances.
  - 13.3.4. Adhere or mechanically fasten rigid insulation to substrate and adhere protective cover board to top of insulation.
  - 13.3.5. Following manufacturer's instructions regarding roof penetrations, end and side overlaps, flashing, parapet and trim detailing.
  - 13.3.6. Provide a double layer of cap sheet and mount pavers or a second layer of protective board at roof traffic pavers as recommended by manufacturer.
  - 13.3.7. Protect areas of roof which are finished from later construction activity.



**Section 07 53 00 Elastomeric Membrane Roofing -Ethylene Propylene Diene Monomer Roofing (EPDM)**

1. When the Department expresses its preference to use a modified bitumen roofing membrane on a specific project and the Consultant wishes to propose use of an Ethylene Propylene Diene Monomer (EPDM) Roofing System, be prepared to demonstrate such use meets or exceeds the requirements for the modified bitumen system.
2. Where Ethylene Propylene Diene Monomer (EPDM) roofing is incorporated into design use a non- ballasted, fully adhered or mechanically fastened method of attachment.
3. Where roofing is applied over metal deck, provide exterior grade non-paper backed drywall, or rigid 1" mineral wool insulation board CAN/CGSB 51.31-M84 actual density of 11 lbs/cuft top surface coated with bitumen on metal deck prior to vapour barrier installation.
4. Cold applied single-ply EPDM
  - 4.1. Standard of Acceptance:
    - 4.1.1. Firestone "Rubbergard Max reinforced"
    - 4.1.2. Carlisle "Sure-Seal" or "Fleeceback"
    - 4.1.3. Approved alternative: Alternatives may be proposed by the consultant and subsequently approved following a comparative review of performance characteristics.
  - 4.2. Warranties to meet the requirements of Section 07 00 00.3, DC350, current edition.
  - 4.3. Installation
    - 4.3.1. Follow manufacturer's instructions regarding use of vapour barrier, primer, membrane material, and rigid insulation as appropriate to the roof deck construction.
    - 4.3.2. Surface to be clean and dry and free of all ice, water, and debris.
    - 4.3.3. Install only when air temperature is within manufacturer's recommended tolerances.
    - 4.3.4. Adhere or mechanically fasten rigid insulation to the substrate and adhere protective cover board to top of insulation.
    - 4.3.5. Adhere or mechanically fasten membrane in conformance with manufacturer's instructions for all work, including roof penetrations, end and side overlaps, flashing, parapet and trim detailing.

- 4.3.6. Use pre-moulded flashing at roof penetrations, as recommended by manufacturer.
- 4.3.7. Provide a double layer of membrane cap sheet or protection board at roof traffic pavers and mount pavers, as recommended by manufacturer.
- 4.3.8. Protect areas of roof which are finished from later construction activity.

**Section 07 54 00 Thermoplastic Membrane Roofing**

1. Where Thermoplastic Membrane roofing (including but not limited to TPO roofing) is incorporated into design use mechanically fastened or fully adhered method of attachment.
2. Where roofing is applied over metal deck, provide exterior grade non-paper backed drywall or rigid 1" mineral wool insulation board CAN/CGSB-51.31-M84 actual density of 11 lbs/cuft top surface coated with bitumen on metal deck prior to vapour barrier installation and 1 layer of protective coverboard, over insulation. See Section 07 20 00 Thermal Protection, Materials, Protective Coverboard

## Section 07 70 00 Roof and Wall Specialties and Accessories

1. Curbs to be minimum 300 mm (12") above drainage plane to top. Detail all penetrations.
2. Where roofing is sloped less than 1:3, provide inserts/slots for the purpose of retaining temporary guard rails (minimum of 42" high), for use during construction and maintenance work.
3. Fall Protection Systems
  - 3.1. Travel Restraint Systems
    - 3.1.1. Include Travel Restraint Systems in design of new flat-roof assemblies, and where major re-roofing of flat-roofs are performed on existing buildings, except where otherwise specified.
    - 3.1.2. Ensure submission of shop drawings for Travel Restraint System in accordance with the General Conditions of Contract. Ensure shop drawing indicate materials, thicknesses, finishes, connections, joints, and methods of anchorage, number of anchors, supports, reinforcement, details and accessories.
    - 3.1.3. Ensure submission of erection drawings as for shop drawing in accordance with General Conditions indicating location for placement.
    - 3.1.4. Ensure coordination of travel restraint design with structural design in new buildings and particularly in existing buildings, where structure may require upgrades to support the travel restraint system. Discuss with DPW staff.
  - 3.2. Other Fall Protection Systems
    - 3.2.1. Discuss other fall protection systems with DPW staff, where building use or maintenance may necessitate such systems.
  - 3.3. Material
    - 3.3.1. Type permanently secured, by bolts or weld, to the building structure and meeting requirements of the Province of Nova Scotia Fall Arrest Legislation and Occupational Health and Safety Act revised Statutes of Nova Scotia 1996, Chapter 7 and regulations; c/w associated fasteners, bolts and cable.
  - 3.4. Execution
    - 3.4.1. Ensure system is installed to manufacturer's printed instructions and is project specific.

- 3.4.2. Ensure the system is installed prior to other work on the roof commences.
- 3.4.3. Ensure the manufacturer's representative inspects and approves, in writing, system installation prior to any use or concealing of work.
- 3.4.4. Ensure the contractor provides the Consultant a copy of manufacturer's inspection, including load test on each anchor, and approval of installation.
- 3.4.5. Review the manufacturer representative's inspection and approval documentation. Where such documentation is satisfactory, direct the contractor to proceed with Work.
- 3.4.6. Ensure the Contractor does not conceal travel restraint work without Consultant's direction.

**Section 07 80 00 Fire and Smoke Protection**

1. Where fire separations are required between assemblies, including floors and rooms, provide a written description of the entire systems being used to achieve fire separations with appropriate ULC number.
2. Show on drawings locations, extent and ratings of fire separations and protections.

## Section 07 84 00 Firestopping

### 1. Materials

#### 1.1. Fire stopping and Smoke seal systems

1.1.1. Intumescent type in accordance with CAN/ULC-S115-11

1.1.2. Asbestos-free materials and systems capable of maintaining and effective barrier against flame, smoke and gases in compliance with requirements of CAN/ULC-S115-11 and not to exceed opening sizes for which they are intended.

#### 1.2. Service penetration assemblies

1.2.1. Certified by ULC in accordance with CAN/ULC-S115-11 and listed in the ULC Guide No. 40 U19

#### 1.3. Service penetration fire stop components

1.3.1. Certified by ULC in accordance with CAN/ULC-S115-11 and listed in the ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.

#### 1.4. Fire stopping at openings intended for ease of re-entry such as cables:

1.4.1. Elastomeric seal; do not use cementitious or rigid seal at such locations.

#### 1.5. Fire stopping at openings around penetrations for pipes, duct work and other mechanical items requiring sound and vibration control:

1.5.1. Elastomeric seal; do not use cementitious or rigid seal at such locations.

#### 1.6. Primers

1.6.1. To manufacturer's recommendations for specific material, substrate, and end use.

#### 1.7. Water (where applicable)

1.7.1. Potable, clean and free from injurious amounts of deleterious substances.

#### 1.8. Damming and Back-Up Materials, Supports and Anchoring Devices

1.8.1. To manufacturer's recommendations and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

- 1.9. Sealants for vertical joints
  - 1.9.1. Non-sagging type.
2. Fire-resistance rating of installed fire stopping assembly not less than the fire-resistance rating of the surrounding floor and wall assembly.
3. Where fire separations are required between assemblies, including floors and rooms, provide a written description of the entire systems being used to achieve fire separations with appropriate ULC number.
4. Preparation
  - 4.1. Examine sizes and conditions of voids to be filled to establish correct thickness and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.
  - 4.2. Prepare surfaces in contact with fire stopping materials to manufacturer's printed instructions.
  - 4.3. Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
  - 4.4. Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.
5. Installation
  - 5.1. Install fire stopping material and components in accordance with ULC standard systems certification and Manufacturer's printed instructions.
  - 5.2. Seal holes or voids made by through-penetrations, poke-through termination devices, and openings or joints to ensure continuity and integrity of fire separation are maintained.
  - 5.3. Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
  - 5.4. Tool and trowel exposed surfaces to a neat finish.
  - 5.5. Remove excess compound promptly as work progresses and upon completion.



**Section 07 90 00 Joint Protection**

1. Contractors to submit manufacturers' warranties for the work of this section covering a period of four (4) years beyond the date of expiration of performance assurance.
2. Defective work shall include, but not be restricted to, joint leakage, cracking, crumbling, melting, running, loss of adhesion, loss of cohesion, or staining of adjoining or adjacent work or surfaces. All old or defective caulking shall be removed, and surfaces cleaned before installation of caulking.
3. Acrylic base solvent curing, one component Sealing compound for glass, metal, masonry or wood shall be specified to meet the requirements of CGSB 19-GP-5M.
4. For indoor use in occupied buildings consider the use of one component acrylic emulsion latex water-based sealing compound where the application is appropriate, for metal, concrete, masonry and glass and specified to meet the requirements of CAN/CGSB 19.17-M90 or ASTM C834-17.
5. Elastomeric chemical curing one component sealing compound for metal, concrete, masonry and glass shall be specified to meet the requirements of CAN/CGSB 19.13-M87.
6. Multi-component chemical curing sealing compounds shall be specified to meet the requirements of CAN/CGSB 19.24 M .
7. The sealant for all joints and around all penetrations in slab-on -grade shall be a one- component high performance, polyurethane product installed to manufacturer's specifications.

**END**

## **DIVISION 08 - OPENINGS**

### **Section 08 00 00 Openings - General**

1. Information relates to Department technical requirements regarding doors and frames, specialty doors, entrances and storefronts, windows, skylights, hardware, glazing and glazed curtain wall.
2. Extended Warranty:
  - 2.1. Manufacturer's warranty to be provided which guarantees the all interior and exterior doors, including overhead sectional doors and interior and exterior door hardware, for a minimum period of four (4) years extended beyond the expiration of the performance assurance requirements specified in the General Conditions.
  - 2.2. Manufacturer's warranty to be provided which guarantees all aluminum windows and window and sidelite glazing for a period of four (4) years extended beyond the expiration of the performance assurance requirements specified in the General Conditions.
  - 2.3. Consultant shall confirm with manufacturers that warranties of combined locking hardware components will be covered when different products are used in combination.
  - 2.4. Refer also to Part 1 Section 2, 08 50 00 Windows for additional extended warranty requirements.

## Section 08 10 00 Doors & Frames

1. Doors manufactured from the following materials are acceptable:
  - 1.1. Aluminum
  - 1.2. Wood
  - 1.3. Hollow metal
  - 1.4. Refer to the specific section in this document for more details. The designer is required to select the material most suitable to the specific job requirements.
2. Frames manufactured from the following materials are acceptable:
  - 2.1. Aluminum
  - 2.2. Pressed steel
  - 2.3. Wood
  - 2.4. Refer to the specific section in this document for more details. The designer is required to select the material most suitable to the specific job requirements.
  - 2.5. All exterior frames shall be thermally broken units.
3. Doors and door frames shall be coloured by an appropriate manufactured process or by painting with suitable products on site.
4. Glazing in all exterior doors shall be, as a minimum, double glazed insulated units, argon filled with low-e coating and non-metallic spacers, except as noted otherwise in Part 2, Section 2, Division 08.
5. Ensure fire doors carry an Underwriters Laboratory label of the classes required.
6. Where double doors are incorporated into exterior door design, ensure that a maximum of three (3) exits are designed with removable mullions at locations where a greater entry width is required. Otherwise provide permanent mullions to ensure positive latching.

## Section 08 11 00 Metal Doors and Frames

### 2. Design Criteria

- 2.1. Fabricate steel doors and frames in accordance with Canadian Steel Door and Frame Manufacturer's Association, "Canadian Manufacturing Specifications for Steel Doors and Frames", except where noted otherwise in this document.
- 2.2. For offices, meeting rooms, and other similar rooms identified in the project specific requirements (excluding washrooms and storage rooms) provide:
  - 2.2.1. Solid entry door
  - 2.2.2. A door sidelight, 600mm wide x height matching associated door, c/w horizontal metal window blinds.

### 3. Materials

#### 3.1. Steel Hollow Metal Doors

##### 3.1.1. Sheet steel

- 3.1.1.1. 18 ga base thickness, commercial grade steel to ASTM A1008/A1008M-18, Class 1 finished to ASTM A653/A653M-18 W25 wiped zinc finish.

##### 3.1.2. Glazing stops

- 3.1.2.1. Minimum 20 ga. base thickness sheet steel with W25 wiped zinc finish to ASTM A653/A653M-18 or ASTM A924/A924M-18 screw fixed.

##### 3.1.3. Door Core

###### 3.1.3.1. Exterior Doors:

- 3.1.3.1.1. Hollow steel, vertically stiffened with steel ribs and all voids filled with incombustible, semi-rigid fibrous insulation or urethane, 1.5 lb./cu.ft., minimum density.

###### 3.1.3.2. Interior Doors

- 3.1.3.2.1. Honeycomb, structural core consisting of kraft paper having 3/4" cell size to thickness indicated.
- 3.1.3.2.2. Provide coloured door framing.

###### 3.1.3.3. Fire Doors

- 3.1.3.3.1. Fire doors shall carry a Fire Underwriter's Laboratory label of classes as required by the drawings.

3.1.3.4. Primer

3.1.3.4.1. For touch up to CAN/CGSB 1.181-99.

3.2. Pressed Steel Frames

3.2.1. Sheet steel

3.2.1.1. Commercial grade steel to ASTM A1008/A1008M-18, Class 1 finished to ASTM A653/A653M-18 W25 wiped zinc finish.

3.2.2. Frames: generally 16 ga. base thickness steel.

3.2.3. Floor anchors, channel spreaders and wall anchors: minimum 16 ga. base thickness steel.

3.2.4. Guard boxes: minimum 22 ga. base thickness steel.

3.2.5. Glazing stops: minimum 20 ga. base thickness steel, tamper proof.

3.2.6. Reinforcing channel: to CSA G40.20-13/G40.21-13 (R2018), type 300W.

3.2.7. Door bumpers: black neoprene single stud.

3.2.8. Primer to CAN/CGSB 1.181-99.

## Section 08 11 16 Aluminum Doors and Frames

Check with current building code for structural requirements.

### 1. Design Criteria

- 1.1. Where Aluminum Doors and Frames are incorporated into design use heavy duty materials, complete with hardware, exterior stops and tamper proof hinges.
- 1.2. All main entrance doors and frames shall consist of aluminum sections and tempered glass. These doors will be equipped with an automatic closer and holding mechanisms. At least one main entrance door and frame system shall consist of a double with removable mullion to allow a minimum opening of 1.5 m.

### 2. Materials

- 2.1. Aluminum extrusions
  - 2.1.1. Aluminum Association alloy AA6063-T5, anodizing quality.
- 2.2. Sheet aluminum
  - 2.2.1. Aluminum Association alloy AA5005-H32.
- 2.3. Steel reinforcement
  - 2.3.1. To CSA G40.20-13/G40.21-13 (R2018), grade 44W hot dip galvanized to CSA G164-18.
- 2.4. Fasteners
  - 2.4.1. aluminum, or stainless steel, finished to match adjacent material.
- 2.5. Weatherstrip
  - 2.5.1. Replaceable mohair.
- 2.6. Isolation coating
  - 2.6.1. Alkali resistant, bituminous paint or epoxy solution.
- 2.7. Glass
  - 2.7.1. Tempered glass to CAN/CGSB 12.1-2017, Type 2, Class B.
- 2.8. Finishes
  - 2.8.1. Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes - 1980.

### 3. Fabrication

#### 3.1. Design frames and screens in exterior walls to:

- 3.1.1. Accommodate expansion and contraction within service temperature range of -35 deg.C to 75 deg. C.
- 3.1.2. Make allowances for deflection of structure. Ensure that structural loads are not transmitted to aluminum work.

#### 3.2. Provide replaceable weatherstripping at exterior and vestibule door openings. Weatherstrip bottom of doors with pile sweep strip applied to door rail.

#### 3.3. Aluminum Frames and Screens

- 3.3.1. Frames for doors and screens to be aluminum extrusions 1-3/4" x 4-1/2" with minimum wall thickness 0.120".

#### 3.4. Aluminum Doors

- 3.4.1. Construct doors of porthole extrusions with minimum wall thickness of 0.120".
- 3.4.2. Construction: heavy duty, minimum style size 1 3/4" x 4".
- 3.4.3. Reinforce mechanically joined corners of doors by welding, spigotting, welding and spigotting or by one piece of cast aluminum angle to produce sturdy door unit.
- 3.4.4. Glazing stops: interlocking snap-in type for dry glazing. Exterior stops: tamper proof type.

### 4. Installation

#### 4.1. Arrange components to prevent abrupt variation in colour.

#### 4.2. Door frames shall be set plumb and square, properly and well secured to the surrounding structure.

#### 4.3. Cavities between frames and the rough opening should be filled with foamed-in insulation.

#### 4.4. The exterior joints between the frames and the adjacent building material shall be carefully caulked.

#### 4.5. Install doors and hardware in accordance with hardware templates and manufacturer's instructions.

#### 4.6. Adjust hardware for smooth operation.

## Section 08 14 00 Wood Doors

1. Design Criteria
  - 1.1. Refer to general comments - Section 08 00 00.
  - 1.2. All wood flush doors shall be seven-ply solid core with hardboard face.
  - 1.3. Use Nova Scotia manufactured hardboard faces whenever possible.
2. Materials
  - 2.1. Solid core door materials: to CSA 0132.2.
3. Fabrication
  - 3.1. Vertical edge strips shall match the face veneer.
  - 3.2. Prepare doors as required for items such as glazing and louvres. Glazing stops to match face veneer.
4. Installation
  - 4.1. Install doors and hardware in accordance with manufacturer's instructions.



## Section 08 30 00 Specialty Doors

### 1. Sectional Overhead Doors

#### 1.1. Design Criteria

- 1.1.1. Design exterior door assembly to withstand windload with pressures of 120 km/hr with a maximum horizontal deflection of 1/240 of opening width.
- 1.1.2. Exterior doors to be insulated.

#### 1.2. Products

##### 1.2.1. Material

- 1.2.1.1. Galvanized steel sheet: Commercial quality with zinc coating.
- 1.2.1.2. Exterior sheet steel: 20ga. Prepainted hot dipped galvanized.
- 1.2.1.3. Interior sheet steel: 20 ga. Galvanized cover sheets.

##### 1.2.2. End caps: 16 ga. Galvanized end caps.

- 1.2.2.1. Finish coat: factory applied, baked on acrylic enamel finish from Manufacturer's standard colour range.

##### 1.2.3. Doors

- 1.2.3.1. Door sections: Insulated, thermally broken, steel polyurethane steel sandwich formed by a continuous process and complete with ship lapped joints. Reinforcements to be minimum 14-gauge steel or wood blocking.
- 1.2.3.2. Continuous neoprene bulb weatherstrip full width of door bottom.
- 1.2.3.3. Provide electromechanical reversing safety bar full width of door section with tie into door operator.
- 1.2.3.4. Hardware: all door face hardware, tracks and track mounting and torsion assembly to be hot dip galvanized, minimum 14 gauge.
- 1.2.3.5. With Division 16 provide all accessories necessary for proper function of door including rollers, roller brackets,

counterbalances and other accessories as warranted by project.

2. Special Function Doors

2.1. Design Criteria

2.1.1. Sound Control Doors

- 2.1.1.1. Consider use of Sound Control Doors for incorporation into design to maintain room STC ratings.
- 2.1.1.2. Ensure such doors have appropriate gaskets and seals about door perimeter and bottom.

**Section 08 42 29 Automatic Entrances**

1. Automatic entrance equipment must be capable of interface with access control systems.

## Section 08 50 00 Windows

### 1. Windows

- 1.1. All exterior windows shall meet the performance requirements as calculated and required by the most recent issue of CSA A440-17, Windows.
- 1.2. Refer to the specific section in this document for more details. The designer is required to select the material most suitable to the specific job requirements. Windows manufactured from the following materials are acceptable:
  - 1.2.1. Aluminum
  - 1.2.2. Vinyl
- 1.3. The designer is required to select the operator most suitable to the specific job requirements. The following types of operable windows are generally acceptable, expect as noted otherwise in Part 2, Section 2, Division 08.
  - 1.3.1. Projected
  - 1.3.2. Horizontal slider
  - 1.3.3. Vertical slider
  - 1.3.4. Casement
  - 1.3.5. Awning
  - 1.3.6. Tilt and turn
- 1.4. Windows shall be coloured by an appropriate manufactured process or by painting with suitable products on site.
- 1.5. Glazing in all exterior windows shall be, as a minimum, double glazed insulated units, argon filled with low-e coating and non-metallic spacers, expect as noted otherwise in Part 2, Section 2, Division 08.

### 2. Design Criteria

- 2.1. Window Area:
  - 2.1.1. Carefully consider orientation, size and characteristics of glazing to take into account the impact of solar gain, glare and day lighting requirements which may result in different sizes, R values, and the like. For type, number, and percentage of window area, as well as operable or fixed, refer to the project specific requirements and coordinate with DPW Project Design Leader.
- 2.2. Locate windows in the main element of the wall, on the warm side of the plane of the insulation. Do not place window frames in the veneer.

- 2.3. Use triple glazing only when approved.
  - 2.4. Provide insect screens, removable from the interior, on operable windows.
  - 2.5. Weather stripping shall be constructed of a material that is resistant to deterioration by weathering or aging and shall be compatible with associated materials. Weatherstripping shall be mechanically secured in position and shall be replaceable.
  - 2.6. Provide brick mould, sill extender, drywall receiver and other accessories required for suitable detailing and technical performance of exterior veneers and interior finishes.
3. Fabrication
    - 3.1. Fabricate units to project dimensions and as confirmed on site.
    - 3.2. Fabricate window units square and true with maximum tolerance of plus or minus 1/16" for units with diagonal measurement of 6'-0" or less, and plus or minus 1/8" for units with diagonal measurement over 6'-0".
    - 3.3. Make allowance for deflection of structure. Ensure that structural loads are not transmitted to windows.
    - 3.4. Manufacturer's nameplates on windows are not acceptable.
    - 3.5. Install air seal gasket at factory as detailed.
    - 3.6. Install removable insect screens in all opening sashes (on interior side of window only).
  4. Glazing
    - 4.1. Glaze and install windows in accordance with CSA A440-17 and as required for the selected window material and operation.
    - 4.2. Thermal glazing unit: double glazed sealed unit.
  5. Hardware
    - 5.1. Finish: stainless steel or white bronze.
    - 5.2. Types: use the most appropriate hardware, approved by the manufacturer, for the window material and operation either singly or in combination, including:
      - 5.2.1. cam handles
      - 5.2.2. roto-operators
      - 5.2.3. tilt-turn
        - 5.2.3.1. Stainless appearance for colour compatibility with all profile colours.

- 5.2.3.2. Single handle operation tilt before turn for easiest operation into venting position.
- 5.2.3.3. Intermittent Stop Arm type hardware to hold the window in any position when open.
- 5.2.3.4. Custodial Lock type entry resistant tilt-turn hardware for prevention of unlawful entry, including lockable handles to allow only authorized use of swing-in sash position for cleaning purposes, blocking unauthorized exterior access in institutional buildings and for increased safety in high rise applications.
- 5.2.4. Spring catch - for pole operation of vents.

## 6. Installation

- 6.1. Windows are to be installed in accordance with CSA A440.4:19 and according to the manufacturer's instructions. Verify window openings to ensure all framing members are securely in place and all barriers (air and vapour) are installed.
- 6.2. Mock-up of window installation required for approval.
- 6.3. Arrange components to prevent abrupt variation in colour.
- 6.4. Window frames should be set plumb and square, properly and well secured to the surrounding structure, according to the manufacturer's instructions.
- 6.5. Cavities between window frames and the rough opening should be filled with foamed-in insulation.
- 6.6. The exterior joints between window frames and the building opening should be carefully caulked.
- 6.7. Adjust hardware for smooth operation.

## Section 08 51 00 Metal Windows

### 1. Aluminum Windows

#### 1.1. References and Quality Work:

1.1.1. To recent issue of CSA A440-17 as follows:

Vertical Slider Unit	Air leakage	A-3
	Water leakage	B-7
	Wind load resistance	C-4
Fixed or Projected	Wind load resistance	C-5
	Screen strength	S-1
	Forced entry	F-10

1.1.2. All windows by the same manufacturer.

1.1.3. Sash: aluminum

1.1.4. Main frame: aluminum, thermally broken.

#### 1.2. Certificates:

1.2.1. Submit manufacturer's certificate, certifying compliance with specification requirements, for:

1.2.1.1. Windows

1.2.1.2. Infiltration/exfiltration rates

1.2.1.3. Thermal transfer resistance of frames

1.2.1.4. Anodized aluminum finish

1.2.1.5. Architectural coatings

#### 1.3. Isolation

1.3.1. Isolate aluminum from adjacent components, as required, by means of isolation coating.

#### 1.4. Finish: Clear Anodized.

## Section 08 53 00 Plastic Windows

### 1. Vinyl Windows

#### 1.1. References and Quality Work:

- 1.1.1. Conforms to latest NBC, Clause 9.7.2.1 and most recent issue of CSA A440-17 as follows:

Air Leakage	A-3
Water Leakage	B-4
Wind Load Resistance	C-4
Screen Strength	S-1
Forced Entry	F-10

#### 1.2. Extended Warranties:

- 1.2.1. In addition to the standard extended warranty required for Windows as specified in Section 08 00 00, provide for the following manufacturer's warranties on materials:

- 1.2.1.1. PVC frame - lifetime
- 1.2.1.2. Hardware - lifetime
- 1.2.1.3. Glazed sealed units - 10 years

#### 1.3. Components

##### 1.3.1. Frame

- 1.3.1.1. Thickness: multi-chambered 3-1/4"
- 1.3.1.2. Assembly: fusion welded corners
- 1.3.1.3. Cam lock and keeper system as per manufacturer's recommendations

##### 1.3.2. Screens

- 1.3.2.1. Full screen which is removable from the inside with white aluminum frame and fiberglass cloth (grey/black).



**Section 08 60 00 Roof Windows and Skylights**

1. Where roof windows or skylights are incorporated into the design, use translucent glazing systems to minimize heat gain and improve the quality of the light delivered to occupied spaces. Transparent glazing may be used with DPW approval.
2. Standard of Acceptance for translucent glazing systems:
  - 2.1. Solera Advanced Glazing or approved equal.

## Section 08 71 00 Door Hardware

1. Hardware to be installed to standard hardware location dimensions in accordance with the Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by the Canadian Steel Door and Frame Manufacturers' Association.
2. Keying of hardware shall be coordinated with the client and DPW. Refer to the specific section in this document for details on keying.
3. Design Criteria
  - 3.1. Prior to design and specification development ensure that the client group has been contacted to coordinate individual needs and program related concerns including master or grand master keying requirements.
  - 3.2. Refer to DC350, Part 2, Section 2, Division 08, 08 71 00 for Education related design criteria.
4. Materials
  - 4.1. Door Trim
    - 4.1.1. Specify finish to be generally satin.
  - 4.2. Description of Hardware
    - 4.2.1. Use the following Hardware series numbers when specifying the various items of door hardware. Series numbers may be changed to two digits for small projects.
    - 4.2.2. Series 100 - Door Butts and Hinges.
      - 4.2.2.1. Use series designation 100 for hardware items to specify door hinges, pivots or floor closers, threshold (when part of the floor closer) track and Hangers.
      - 4.2.2.2. Specify by Number of pairs, Type of Bearings, metal, tips, fastenings, size and gauge, options, application (example, full mortise or half-mortise)
      - 4.2.2.3. Size hardware to manufacturer's hinge specification guide to meet requirements including those required by ULC, NFPA (Fire) 80, latest NBC, and required trim clearance, door lining, electric controls.
      - 4.2.2.4. Use heavy weight hardware for doors or doors of high frequency and unusual stress.
      - 4.2.2.5. Use Non-removable pin on exterior doors opening out and reverse bevel on interior doors with locks.

- 4.2.2.6. Exercise care to ensure that floor and sill conditions will accommodate checking floor hinges when specified. Generally, an intermediate pivot is required.
- 4.2.2.7. Butts and Hinges:
  - 4.2.2.7.1. Specify size to suit intended use.
  - 4.2.2.7.2. On exterior doors and doors in wet areas use non-ferrous hinges of bronze or stainless steel.
  - 4.2.2.7.3. On exterior and out swinging doors provide non-removable pins (NRP)
- 4.2.3. Series 200 - Lockset & Latchsets
  - 4.2.3.1. Use series 200 designation for hardware items to specify locksets, latchsets, exit devices, flush bolts, cremone bolts.
  - 4.2.3.2. Specify hardware by manufacturer's line, function, design and finish adding prefix and suffix numbers to qualify selection of options.
  - 4.2.3.3. Conform to manufacturer's reference guides and meeting requirements of ULC, NFPA, and latest NBC.
  - 4.2.3.4. For locks and latches, specify mortised type with lever handles, light, medium or heavy duty as applicable to function and use.
- 4.2.4. Series 300 - Operating Trim
  - 4.2.4.1. Use series 300 for hardware items to specify operating trim such as door pulls, push plates, push and pull bars.
  - 4.2.4.2. Specify model, size, gauge, material, finish options.
  - 4.2.4.3. Ensure Pulls are through bolted, except when the opposite side does not permit.
- 4.2.5. Series 400 - Exit Device Accessories
  - 4.2.5.1. Use series 400 for hardware items to specify exit device accessories, including mullions, co-ordinators, and astragals.
  - 4.2.5.2. Specify hardware for pairs of doors only by description and manufacturer's number designation.
  - 4.2.5.3. For Exit Devices
  - 4.2.5.4. All exit devices required for the project shall be of matching design.

- 4.2.5.5. Provide labeled fire exit devices on fire doors.
- 4.2.5.6. Ensure trim for exist devices are through bolted to the lock style case.
- 4.2.5.7. Where required, exit devices shall have touch bar locked down by inside cylinder feature.
- 4.2.6. Series 500 - Overhead Closing Devices
  - 4.2.6.1. Use series 500 for hardware items to specify surface or concealed overhead closing devices and mounting brackets.
  - 4.2.6.2. Specify finish, manufacturer's series number, and size (where applicable), arm assembly, option suffix complete with accessory numbers.
  - 4.2.6.3. Door Closers and Accessories:
    - 4.2.6.3.1. Specify parallel arm in exposed locations.
    - 4.2.6.3.2. Specify Top Jamb Mounted (TJM) on exterior doors opening out.
    - 4.2.6.3.3. Specify power assist operators with remote pad switch where required by Provincial Building Code N.S. Reg. 44/2019.
- 4.2.7. Series 600 - Door Controls
  - 4.2.7.1. Use series 600 for hardware items to specify door controls including overhead door holders, electro-magnetic holders and smoke/heat detectors.
  - 4.2.7.2. Door control hardware may be required for doors normally held in open position and where a smoke barrier or labeled door is required.
  - 4.2.7.3. Automatic Door Operators
    - 4.2.7.3.1. Ensure closing force and door speed are adjustable to provide appropriate closing control.
    - 4.2.7.3.2. Specify units having a three-position switch (On, Off, Hold Open)
    - 4.2.7.3.3. Ensure the full open position is fully adjustable between 0 to 30 seconds.
    - 4.2.7.3.4. Ensure the door shall close under full spring power when the operator motor is shut off at the unit, using the Off switch.

4.2.7.3.5. Ensure provision of push button switches to assist entrance and exit from the building.

4.2.7.3.6. Ensure signs are provided indicating an automatic barrier free entrance.

4.2.8. Series 700 - Protective Plates and Trim

4.2.8.1. Use series 700 for hardware items to specify protective plates and trim including kick, mop, stretcher and door edges.

4.2.8.2. Specify type, size, material, and finish.

4.2.8.3. Specify plates 50 mm less than door width on push side of single doors and 25 mm less on pairs of doors.

4.2.8.4. Specify plates 12 mm less than door width on pull side.

4.2.8.5. Stretcher plates may be used as a combination push plate and stretcher plate.

4.2.8.6. Specify kick plates on push pull function, push side.

4.2.9. Series 800 - Door Stops, Holders, and Bumpers

4.2.9.1. Use series 800 for hardware items to specify floor or base stops and holders, wall bumpers.

4.2.9.2. Specify wherever an open door or any item of hardware thereon strikes a wall, column, or other part of the building.

4.2.10. Series 900 - Special Door Accessories

4.2.10.1. Use series 900 for hardware items to specify special door accessories including weatherstripping, thresholds (when not specified elsewhere), key control cabinets, letter slots, number and name plate.

4.2.10.2. Specify door gaskets and bottom seal with retract mechanism on acoustic control doors.

4.2.10.3. Specify weatherstripping, applied continuously around perimeter of head, jambs and mullions of exterior doors. Provide weatherstripping of extruded aluminum with neoprene gasket, unless specified otherwise.

5. Keying

5.1. Door keying shall be co-ordinated with DPW.

5.2. Specify grand master key(s) as directed.

5.3. Specify three (3) master keys for each MK group.

- 5.4. Specify duplicate keys for each lock.
- 5.5. Keying code numbers to be stamped on keys and cylinders.
- 6. Installation
  - 6.1. Hardware to be installed to standard hardware location dimensions in accordance with the Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by the Canadian Steel Door and Frame Manufacturers' Association.
  - 6.2. During installation, an Architectural Hardware Consultants shall inspect and certify, in writing, that all items and their installation are in accordance with specified requirements, are functioning properly and are in compliance with the Contract Documents.

**Section 08 74 00 Electro-Mechanical Hardware**

1. Design Criteria
  - 1.1. Magnetic locking systems are not to be used.

## Section 08 80 00 Glazing

### 1. Design Criteria

- 1.1. Use tempered safety glass in traffic doors, vestibules, and borrowed lite units in public areas.
- 1.2. Specify mirrors as part of washroom accessories.
- 1.3. Specify wired glass in fire rated assemblies.

### 2. Materials

- 2.1. Clear Sheet Glass: to CAN/CGSB 12.2-M91 (R2017) B quality.
- 2.2. Polished Plate or Float Glass to CAN/CGSB 12.3-M91 (R2017), glazing quality.
- 2.3. Clear wired glass: to CAN/CGSB 12.11-M90, Type 1, wire mesh style 4, 6 mm (typical) thick.
- 2.4. Insulating Glass Units: Factory sealed double glazed units, argon filled and complete with non-metallic spacers - outer lite tinted (except where noted otherwise for educational facilities in Part 2 Section 2, Division 08, 08 50 00), 1/4" thick, inner lite 1/4" clear plate or float glass, with a hermetically sealed space of 1/2" width.
- 2.5. Clear tempered glass: to CAN/CGSB 12.1-2017, Type 2, Class B 1/4" thick.
- 2.6. One-way mirrored glass: to CAN/CGSB 12.6-M91, Type 1 - metallic coating applied to clear glass.
- 2.7. Silvered mirror glass: to CAN/CGSB 12.5-M86, Type 1A - float glass for normal use.
- 2.8. Glazing and Sealing Compound Materials.
  - 2.8.1. Glazing Compound: oil base, to CGSB 19-GP-6M, Type 1.
  - 2.8.2. Sealant Compound: one component acrylic base, to CGSB 19-GP-5M, gun grade.
  - 2.8.3. Glazing Tape: preformed butyl tape, 10-15 durometer hardness, paper release.
  - 2.8.4. Setting Blocks: neoprene, Shore "A" durometer hardness 70-90.
  - 2.8.5. Spacer shims: neoprene, Shore "A" durometer hardness 40-50.
  - 2.8.6. Primer-sealers and cleaners: to glass manufacturer's standard.



2.9. Non-Vision / Translucent Glazing Units (TGU)

2.9.1. Acceptable translucent glazing unit manufacturers:

2.9.2. Solera by Advanced Glazings Limited, Sydney, N.S. or approved equal.

2.9.3. Fabrication and installation to manufacturer's printed specifications.

**END**

## DIVISION 09 - FINISHES

### Section 09 00 00 Finishes - General

1. Information relates to Department technical requirements regarding metal support assemblies, plaster and gypsum board, tile, terrazzo, ceilings, flooring, wall finishes, acoustical treatment, paints and coatings, and the like.
2. Select materials based on the following:
  - 2.1. Non-toxic
  - 2.2. Minimized off-gassing of volatile organic compounds or other noxious products. Product tested to ASTM D7143 Standard Practice for Emission Cells for the Determination of Volatile Organic Emissions from Indoor Materials/Products.
    - 2.2.1. Paints and adhesives tested for VOC emissions in accordance with ASTM D2832-92 to have low VOC, and /or "Ecologo" labels meeting emission and toxicity standards published by Environment Canada and CSA, or MPI Extreme Green certification.
    - 2.2.2. Total concentration of airborne volatile organic compounds (TVOC) does not exceed 5.0 milligrams per cubic meter of air, and, within that concentration, no single volatile organic compound exceeds 10% of the total airborne volatile organic compounds.
  - 2.3. Maintainable and durable within its installed environment.
3. Where functional requirements indicate use of other products may be warranted, discuss and receive approval from DPW for their use prior to incorporation into design.
4. Consider the use of products manufactured in or near Nova Scotia, manufactured from renewable resources, recycled materials, and companies which have a written, publicly available policy or commitment to operating in a sustainable manner.
5. Natural organic products are preferred to manufactured petroleum-based products.
6. Consider use of contrasting colours between walls, floors, doorways, and stair treads to assist visually challenged people.
7. Consider the psychological effect of colour on people when choosing finishes and justify your choices to DPW.
8. Installation
  - 8.1. Ventilate areas in which adhesives are used.

- 8.2. Barricade or otherwise restrict access to areas where floor placement and finishing are in progress, preventing traffic over flooring.
- 8.3. Cover and protect finished flooring installation with materials adequate to prevent traffic damage. Maintain and replace such cover and protection as necessary until project completion.
9. Gymnasium Flooring Co-ordination
  - 9.1. Except for in-floor accessories, ensure gymnasium equipment and accessories such as backstops, lighting and ductwork, are placed before floor installation.
  - 9.2. Place in-floor accessories after floor surface installation, but before installation of game lines.
10. Mock-ups are required for all finishes.
11. Project manual to specify requirement of system warranty for floor finishes, for a minimum period of four (4) years beyond the date of expiration of performance assurance.

## Section 09 21 16 Gypsum Board Assemblies

### 1. General:

- 1.1. Use water resistant board meeting requirements of ASTM C1396 where gypsum board is required in the design of wet areas including janitor's rooms, washrooms, and showers and install to ASTM C840 except where specified otherwise.
- 1.2. Use metal furring runners, hangers, tie wires, inserts and anchors; galvanized when used in wet or humid areas.

**Section 09 22 16 Non-Structural Metal Framing**

1. General:

- 1.1. When abuse resistant drywall is placed over non-load bearing wall framing, use minimum 20-gauge steel studs, or as required by structural design for loading, wall height, size and spacing.

## Section 09 30 15 Ceramic Tiling

1. General:
  - 1.1. Specify all hard tile to ANSI A137.1 Standards and in accordance with Terrazzo, Tile and Marble Association of Canada (TTMAC) specification guidelines.
  - 1.2. Specify hard tile in all high traffic areas such as lobbies, areas near entry and exit doors, and main corridors.
  - 1.3. Specify hard tile in washrooms and shower rooms. Specify wall tile to extend the full height of the wall in primary and high traffic washrooms and in all shower areas. In secondary, low traffic washrooms, specify tile to cover the lower half of the wall at a minimum.
  - 1.4. Specify hard tile in commercial kitchens
2. Products:
  - 2.1. Washroom / Shower Floor Tile:
    - 2.1.1. Specify unglazed, vitreous or impervious non-slip porcelain tile.
    - 2.1.2. Specify bullnosed exposed edges, cove base where project budget permits.
    - 2.1.3. Pattern as approved by IAH
  - 2.2. Washroom / Shower Wall Tile:
    - 2.2.1. Specify glazed or unglazed, vitreous or impervious porcelain or ceramic tile.
    - 2.2.2. Pattern as approved by IAH
  - 2.3. Kitchen Floor Tile:
    - 2.3.1. Specify unglazed, vitreous or impervious non-slip quarry or porcelain tile
    - 2.3.2. Specify tile that is colourfast, impervious to bacteria, odorless, pressure impact resistant, and scratch resistant.
3. Execution:
  - 3.1. Install tile in accordance with details and specifications of the Terrazzo, Tile and Marble Association of Canada Installation (TTMAC) Manual.

## Section 09 54 23 Acoustical Panel Ceilings

1. General:
  - 1.1. Maximum deflection: 1/360th of span to ASTM C 635, deflection test.
  - 1.2. Select tile to meet acoustic requirements.
2. Products:
  - 2.1. Exposed T-Bar Grid Components:
    - 2.1.1. Two direction 24" x 48" (610mm x 1220mm) or 24" x 24" (610mm x 610mm) shop painted, satin sheen, and white colour unless noted otherwise. Die cut components.
    - 2.1.2. Main T with double web, rectangular bulb and 1" rolled cap on exposed face. Cross T with rectangular bulb, web extended to form positive interlock with main T webs; lower flange extended and offset to provide flush intersection.
  - 2.2. Acoustical Ceiling Tile:
    - 2.2.1. ASTM C423 rated NRC 0.90 or better for open office, and 0.70 or better for closed office.
    - 2.2.2. ASTM E1110-06 rated AC190 for open office or ASTM E1414/E1414M rated minimum CAC 35 for closed office.
    - 2.2.3. White in colour, with high light reflectance.
    - 2.2.4. Fire rated as required and approved by NS Fire Marshall's office.
3. Exposed structure is acceptable for use as a ceiling in gymnasias, storage rooms, workshops, etc., or as indicated in project specific programs. Coordinate exposed structure ceilings with required fire separations.
4. Use acoustic tile ceilings in meeting rooms, administrative offices and open office areas, and rooms dedicated to learning and lecturing or as otherwise directed by DPW.

## Section 09 64 29 Wood Strip and Plank Flooring

1. Extended Warranties:
  - 1.1. Provide manufacturer extended warranty for guarantee of performance and structural integrity of the system for a period of four (4) years beyond the date of expiration of the performance assurance.
  - 1.2. Provide flooring contractor extended warranty of four (4) years beyond the date of expiration of the performance assurance requirements specified in the General Conditions, against defects in installation workmanship and certify that all materials and components are as supplied by or approved by the floor system manufacturer.
2. Environmental Requirements
  - 2.1. Flooring to be installed only in area maintained at an air temperature of not less than 180C nor more than 320C for a period of at least 72 hours before installation, during installation and until finishing has been completed and has cured.
  - 2.2. Do not allow temperatures to fall below 130C
  - 2.3. Flooring to be stored and installed only in areas where the relative humidity does not exceed 55%.
  - 2.4. Flooring to be installed only after completion of masonry, drywall, and other similar work which would introduce moisture into the room's environment.
  - 2.5. Floor construction to be broom clean and free of foreign material.
  - 2.6. Floor finishing to be done only in dust-free areas.
  - 2.7. Gymnasium equipment, including backstops, lighting and ductwork, to be placed before floor installation.
  - 2.8. Ventilate areas in which adhesives are used.
3. Products:
  - 3.1. Specify kiln dry flooring and ensure, at time of installation, flooring has an average moisture content of 8%, with a tolerance ranging from minimum 6% to a maximum of 10% in individual pieces.
  - 3.2. For gymnasium strip flooring, specify:
    - 3.2.1. Northern Hard Maple, strip flooring.
    - 3.2.2. 25/32" x 1 ½". Tongue and groove edges and matched ends.
    - 3.2.3. Grades: No.



- 3.2.3.1. 2 or better grade to CLA Grading Rules for Canadian Hardwood Strip Flooring, latest edition, minimum 50% No. 1 stock or,
- 3.2.3.2. Grade 3 or better select Northern hard maple to MFMA grading Rules.
- 3.2.4. Maximum average moisture content of 8%.
- 3.2.5. No knots larger than 3mm diameter.
- 3.2.6. Slight imperfections in color or surface of finish wood capable of sanding out prior to application of floor finish.
- 3.2.7. Slight check no longer than 75mm are acceptable in stock on less than 1% of floor area.
- 3.2.8. No bark streaks shall be permitted.
- 3.3. For Stage strip flooring, specify
  - 3.3.1. Leading edges:
    - 3.3.1.1. 25/32" x 1 1/2", T&G, No. 2 or better grade to CLA Grading Rules for Canadian Hardwood or, No. 3 or better grade, select Northern Hard Maple, MFMA Certified.
    - 3.3.1.2. Remainder of Stage area 25/32" thick, T&G, Clear No. 1 Grade, white pine.
- 3.4. Where Wood Parquet Flooring is incorporated into the design,
  - 3.4.1. Specify premium mixed maple or birch, 1/2" thick, basket weave pattern, square edge slats of solid hardwood.
  - 3.4.2. Sand with at least 3 cuts using course, medium and fine and a screen and disc final sanding providing a smooth, even surface, free of scratches. Vacuum thoroughly and clean. Apply two (2) coats of sealer. Lightly disk (steel wool). Vacuum and double tack rag. Apply lines, if required. Apply 2 finish coats.
- 3.5. Where Resilient Wood Flooring Systems are incorporated into the design,
  - 3.5.1. Specify Vapour Retarder.
  - 3.5.2. Specify Wood Subfloor having:
    - 3.5.2.1. 1/2" x 4' x 8' (5-ply) plywood with "air thrust" pads" 8" c. to c.
    - 3.5.2.2. Pads approximately 2" x 2" x 9/64 stapled.
    - 3.5.2.3. First plywood layer long axis of room with 1/4" expansion void.

3.5.2.4. Second T&G plywood layer 0 to first, power nailed with 1" perimeter expansion voice and at perimeter obstructions.

3.6. Accessories and Wood Flooring Systems

3.6.1. For Wood Flooring Systems and accessories for educational facilities, including fasteners, membranes, pads, bases, sub floor systems, refer to DC350 - Part 2, Section 2, Division 09.

3.7. Finishes:

3.7.1. Provide urethane floor finish.

3.7.2. Game Lines

3.7.2.1. Refer to DC350, Part 1, Section 2, Division 09, item 09 90 00.

4. Execution

4.1. Specify according to standard manufacturer's instructions for installation including storage, surface preparation, environmental conditions, adhesives, application, finishing etc.

including but not limited to the following.

4.1.1. Place flooring only up Flooring Contractor's and Manufacturer's acceptance of building conditions; and

4.1.2. When environmental conditions have been provided as specified; and

4.1.3. When other Work of the project, which in execution could interfere with or damage flooring installation, has been completed.

4.1.4. Remove dirt, oil, grease, and other foreign material during sub-floor preparation, ensuring no contaminants are present on sub-floor that would affect adhesive bonding

4.1.5. Defective work resulting from installation of flooring on unsatisfactory surfaces or because of adverse environmental conditions will be considered the responsibility of those performing the Work.

4.2. Provide vapour barrier as required.

4.3. Provide sub-floor as required.

4.4. Provide flooring, penetrations, accessories, and finishes as required.

4.5. Sand flooring after completion of work by other trades.

- 4.6. Thoroughly vacuum flooring between sandings with heavy duty commercial type vacuum.
- 4.7. Inspect work prior to start of finishing operation. When installation is satisfactory authorize start of finishing operation. Ensure finishing operation, including provision of game lines, does not commence without the Flooring Contractor's and Manufacturer's authorization to proceed

## Section 09 65 16 Resilient Sheet Flooring

### 1. Materials:

#### 1.1. Linoleum Sheet:

- 1.1.1. Consider that sheet linoleum material is resistant to indentation from static load but may be affected by moisture and alkali. Use only in appropriate environmental conditions.
- 1.1.2. To ASTM F2034. 2.5mm (64mm) minimum thickness, 2m (6'-6") minimum width.
- 1.1.3. Design elements shall extend throughout the thickness of the wear layer.

#### 1.2. Sheet Vinyl

- 1.2.1. To ASTM F1303 - 04(2014) or CSA A126.3
- 1.2.2. Consider that sheet vinyl material during extreme temperature changes may cause expansion/contraction. Use only in appropriate environmental conditions
- 1.2.3. Specify homogeneous flooring in heavy use areas, and either homogeneous or non-homogeneous flooring with minimum 0.5mm (0.08") wear layer thickness in light use areas.

#### 1.3. Vulcanized rubber

- 1.3.1. To ASTM F1860-14e1 or ASTM F1859-14e1.

#### 1.4. Resilient Nylon Sheet Flooring:

#### 1.5. Resilient Base:

- 1.5.1. to ASTM F1861
- 1.5.2. Specify top set coved rubber, Minimum 1220mm (4'-0") length x 100mm (4") high, complete with pre-molded end stops and pre-molded external corners.

#### 1.6. Resilient Stair Riser:

- 1.6.1. Top set vinyl, 3mm (1/8") thick, full riser height, solid pattern.

#### 1.7. Resilient Stair Tread: to ASTM F2169

- 1.7.1. Top set vinyl, 3mm (1/8") thick x full tread width x full tread length.

2. Execution:

- 2.1. Specify according to standard manufacturer's instructions for installation including storage, surface preparation, environmental conditions, adhesives, application, finishing etc.
- 2.2. Provide reducer strips, transition strips, top caps, termination bars and other accessories where appropriate, including at exposed edges of resilient sheet material terminations, at door thresholds, at changes of floor finishes and changes in heights of materials:
- 2.3. Install with the least number of joints, with joints aligned and parallel to building lines.
- 2.4. Terminate resilient sheet flooring at center line of door where adjacent floor finish or colour is dissimilar.
- 2.5. Where carpet is part of the design, install toeless type base prior to carpet installation.
- 2.6. Provide stair riser and nosing as one piece for full width of stair.
- 2.7. Specify the requirement for a manufacturer's representative inspection of the installation to ensure compliance with installation requirements and product quality and provide an inspection report to the Minister.

## Section 09 65 19 Resilient Tile Flooring

### 1. Materials:

#### 1.1. Vinyl Composition Floor Tile (VCT) :

1.1.1. to ASTM F1066

1.1.2. Minimum 3mm (0.125") overall thickness with through-pattern

#### 1.2. Luxury Vinyl Floor Tile or Planks (LVT):

1.2.1. to ASTM F1700

1.2.2. Minimum 2.5mm (0.1") overall thickness with minimum 0.5mm (0.02") thick wear layer

#### 1.3. Rubber Floor Tile:

1.3.1. to ASTM F1344

#### 1.4. Linoleum Floor Tile:

1.4.1. to ASTM F2195

#### 1.5. Nylon Floor Tile:

1.5.1. To ASTM

### 2. Execution:

2.1. Consider that tile may have a tendency to shrink under extreme sunlight and prolonged excessive heat or cold conditions.

2.2. Specify according to standard manufacturer's instructions for installation including storage, surface preparation, environmental conditions, adhesives, application, finishing etc.

2.3. Install with joints aligned and parallel to building lines,

2.4. , producing symmetrical tile pattern with border tile having a minimum of a half tile width.

2.5. Terminate at center line of door where adjacent floor finish or colour is dissimilar.

## Section 09 66 23 Resinous Matrix Terrazzo Flooring (Fluid Applied Flooring)

1. General:
  - 1.1. Specify materials incorporating the manufacturer's latest improvements in materials in place at the time of manufacture.
  - 1.2. Installation of the flooring system is to be carried out by an experienced and certified floor contractor approved by the manufacturer in accordance with the most recent installation instructions of the manufacturer.
2. Materials:
  - 2.1. Seamless Composite Floor System, Urethane composition
  - 2.2. Free of heavy metals such as lead or mercury
  - 2.3. Type designed to chemically react with previous layers, enhancing bonding.
  - 2.4. Have a minimum thickness of 11mm, with a minimum wear layer of 2mm, unless otherwise approved by DPW
  - 2.5. For sports floors, flooring system to be DIN tested, rated, and meet the following:
    - 2.5.1. Surface hardness meeting DIN ISO 7619-1 or ASTM D2240-15e1 Shore A 80
    - 2.5.2. Elongation at Break DIN 53571 140%
3. Execution:
  - 3.1. Ensure placement occurs only on Flooring Contractor's and Manufacturer's acceptance of building conditions.
  - 3.2. Ensure appropriate environmental conditions have been provided.
  - 3.3. Ensure other Work of the project, which in execution could interfere with or damage flooring installation, has been completed.
  - 3.4. Ensure sub-floor preparation includes removal of dirt, oil, grease, and other foreign material; ensuring no contaminants are present on sub-floor that would affect the work.
  - 3.5. Ensure defective work resulting from installation of flooring on unsatisfactory surfaces or because of adverse environmental conditions will be considered the responsibility of those performing the Work.
4. Installation
  - 4.1. Ensure sub-floor is provided as required.

- 4.2. Inspect sub-floor prior to start of placing fluid-applied membrane. When the sub-floor conditions are satisfactory authorize start of placing the membrane. Ensure membrane placement operation does not commence without the Consultant's authorization to proceed.
  - 4.3. Ensure flooring, penetrations, accessories, sealers and finishes are provided as required.
  - 4.4. Inspect work prior to start of finishing operation. When installation is satisfactory authorize start of finishing operation. Ensure finishing operation, including provision of game lines, does not commence without the Flooring Contractor's and Manufacturer's authorization to proceed.
5. Game Lines
    - 5.1. Refer to DC350, Part 1, Section 2, Division 09, item 09 90 00.



**Section 09 68 00    Carpeting**

1. Specify branded nylon, antistatic, 26 oz minimum with no less than 12 kilotex, solution dyed, or as approved by DPW.
2. Green Label Plus registered or products tested to ASTM D6670-18 preferred.
3. Install with manufacturer's approved adhesive.

**Section 09 72 16 Vinyl-Coated Fabric Wall Coverings**

1. Where vinyl-coated fabric wall covering is to be used refer to project specific statements or client requirements or obtain approval in writing from DPW prior to specifying or installing such materials.
2. Refer to DC350, Part 2, Section 2, Division 09, or project specific statement of requirements for requirements concerning use Vinyl - Coated Fabric Wall Covering.

## Section 09 80 00 Acoustical Treatment

### 1. General

- 1.1. Acoustical materials include as follows: loose fill, spray-on, cementitious wood fibre and cellular glass and rockwool batt insulation.
- 1.2. Where sound control in a school is a concern, as in music rooms, drama rooms, gymnasium, stages, and cafeteria; use fabric wrapped acoustic panels. Refer to DC350, Part 2, Section 2, Division 09.
- 1.3. Acoustical Insulation and Sealants
- 1.4. Where Acoustical Insulation or Barriers are incorporated into the design:
  - 1.4.1. Provide and detail methods to control Airborne sound transmission through partitions and ceiling assemblies by use of proper absorption and insulating media.
  - 1.4.2. Provide and detail silencers and separators to control vibration isolation by use of pads, mounts, springs, hangers, etc.
    - 1.4.2.1. Refer to Part 1, Section 1 Acoustics. Acoustic Treatment to be selected to achieve required acoustic performance including: the minimization of noise transmission from one space to another; appropriate reverberation times with no echo's or flutter echo; uniform sound distribution, appropriate sound levels, and low background noise.

### 2. Materials:

- 2.1. Sound Absorptive Prefabricated Acoustical Units to CAN/CGSB 92.1. Where sound absorbing panels are a part of the design, provide panels:
  - 2.1.1. Panels to be Class A or Class 1 laboratory tested to ASTM E84. Panels are to meet NBC or a smoke development of 50 or less, and have a flame spread rating of 25 or less. Whatever is the most restrictive.
  - 2.1.2. Minimum thickness of 2" (50mm) and as required to meet acoustic requirements of space.
  - 2.1.3. Covered with the manufacturer's standard fabric covering
  - 2.1.4. Acoustic panels to have a minimum core density of 7 lb/ft<sup>3</sup>, (112kg/m<sup>3</sup>) for fiberglass material.

- 2.1.5. Where possibility of impact exists specify impact resistant panels, with scrim facing between fabric and insulation board.
  - 2.2. Acoustical Insulation and Sealants to meet South Coast Air Quality Management District (SCAQMD), California State Rule 1168-Adhesives and Sealant Applications- VOC levels.
  - 2.3. Select materials with high recycled content post-industrial and post-consumer content when possible.
  - 2.4. Cementitious wood fibre acoustics units shall be formaldehyde free to CAN/CBSB 92.
3. Execution
  - 3.1. Installation of panels is to be complete in compliance with manufacturer's written recommendations or specifications including product technical bulletins, handling, storage, and installation instructions, and data sheets.

## Section 09 90 00 Painting and Coating

1. Environmental Requirements
  - 1.1. Refer to Part 1, Section 2, Division 09, item 09 90 00 for environmental requirements.
  - 1.2. Do not apply paint finish in areas where dust is being generated
  - 1.3. Areas in which paint is applied to be well ventilated and broom clean.
  - 1.4. Apply paint when a uniform minimum 100 deg. C air temperature has been achieved in the
  - 1.5. installation area for 24 hours prior to, during and 24 hours after application.
2. References
  - 2.1. CAN/CGSB 85.100-93
  - 2.2. MPI Architectural Painting Specification Manual.
  - 2.3. Environmental Choice Program
  - 2.4. Systems and Specifications (SSPC) Manual, latest Edition and Volume, published by the Society for Protective Coatings.
3. Product submission information to include the following:
  - 3.1. Finish formula designation.
  - 3.2. Product type and use.
  - 3.3. Manufacturer's Product Data.
  - 3.4. Colour number.
  - 3.5. Manufacturer's Material Safety Data Sheets (MSDS).
  - 3.6. Maximum VOC classification.
  - 3.7. EcoLogo, Green Seal or MPI Extreme Green certification.
4. Quality Assurance: Standard of Acceptance for paint finishes
  - 4.1. Walls. No defects visible from a distance of 3' - 0" at 90 degrees to surface.
  - 4.2. Ceilings. No defects visible from floor at 45 degrees to surface when viewed using final lighting source.
  - 4.3. Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

5. Paint manufacturer shall be represented by a qualified technical representative, trained as a paint inspector, with a minimum of 5 years' experience, or as required by individual project specification.
  - 5.1. To ensure proper application the manufacturer's technical representative shall make a minimum of three inspections or inspect as per individual project specification. These inspections shall occur once prior to application, at least once during application and once upon completion of the application.
6. After each inspection the manufacturer's representative shall provide a written report to the representative named in the individual project specification, within 5 working days. Report to identify progress and quality of work and all site instructions given to Contractor.
7. All paint materials for each coating to be products of a single manufacturer.
8. Job Mock-up
  - 8.1. Job Mock-ups shall be required for all projects and shall be specified to meet the following criteria:
    - 8.1.1. Completely finish a sample room for each finishing system to test application procedures and coverage of finish materials. Do not proceed with remainder of Work, including block filling and priming, until sample surfaces are approved.
    - 8.1.2. Additionally, contractor may be required to prepare mock-ups where directed on surfaces that are not a part of the sample wall.
    - 8.1.3. Test paint materials and application equipment for electrostatically painted surfaces for compatibility prior to application.
    - 8.1.4. Prepare sample rooms and mock-ups under supervision of material manufacturer's representatives. Manufacturer's representatives shall be present during application of all materials for mock-ups.
    - 8.1.5. Job mock-up is to form the standard of acceptance for colour, texture, gloss and coverage of application and must be approved by Consultant and paint manufacturer's representative prior to commencement of work on project.
    - 8.1.6. Ensure that painting contractor is prepared to provide the Consultant with affidavits stating only specified products are used in Contract.

9. Start-up Meeting

9.1. Include in the Specification the requirement for a start-up meetings after Award of Contract and prior to the preparation of a sample room, to be held with the following people present:

9.1.1. The Consultant.

9.1.2. The applicator and his site crew.

9.1.3. The paint manufacturer's trained paint inspector or technical representative.

9.2. The purpose of the meeting shall be to discuss the specifications, job conditions, and painting and coating work to be done with reference to the most recent product data sheets and application instructions. Sample rooms will be designated by the Consultant at this meeting.

10. Materials

10.1. CAN/CGSB 85.100-93 or MPI Approved Products.

10.2. Qualified products: only paint materials listed as EcoLogo Approved Products, MPI Extreme Green or Green Seal products are acceptable.

10.3. Paint materials for each coating system to be products of a single manufacturer.

10.4. Low odor products. Whenever possible, select products exhibiting low odor characteristics. If two products are otherwise equivalent, select the product with the lowest odor.

10.5. Products applied to mechanical systems for protection or identification shall be suitable for substrate and exposures.

10.6. For additional shop coat primer and finishing requirements refer also to Part 1 Section 2, Metal Fabrications 05 50 00 and Metal Stairs and Ladders 05 51 00.

11. Maintenance Materials

11.1. Provide maintenance and extra materials in quantities specified in individual specification sections.

11.2. Provide items of same manufacture and quality as items in the Work.

11.3. Deliver to Project site place and store.

11.4. Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual specified in Section 01 78 00 - Closeout Submittals.

- 11.5. Obtain receipt for delivered products and submit prior to final payment.
- 11.6. Submit one-four litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.
- 11.7. Deliver to Owner and store where directed.
- 12. Execution
  - 12.1. Specify the best applicable practices of CAN/CGSB 85.100-93 latest version for materials, methods and procedures.
  - 12.2. Cover or mask surfaces adjacent to those receiving finishes.
  - 12.3. Specify appropriate preparation of the various surfaces to receive finish.
  - 12.4. Specify appropriate application methods and procedures for the various finishes.
  - 12.5. Game Lines
    - 12.5.1. Where game lines are required in the design specify enamel paint compatible with floor finish. For colours refer to DC350, Part 2, Section 2, Division 09.
    - 12.5.2. Game line layouts for specific gymnasiums are available from DPW staff. Discuss with and receive Department approval for any deviation from such approved layouts.

**END**



## **DIVISION 10 - SPECIALTIES**

### **Section 10 00 00 Specialties - General**

1. Information relates to Department technical requirements regarding visual display boards, compartments and cubicles, louvers and vents, grilles and screens, service walls, wall and corner guards, access flooring, pest control, manufactured exterior specialties, flagpoles, identification devices, pedestrian control devices, lockers, fire protection specialties, protective covers, postal specialties, Partitions, storage shelving, exterior protection, telephone specialties, toilet/bath/and laundry accessories, scales, wardrobe and closet specialties , and the like.

## Section 10 11 00 Visual Display Surfaces

### 1. Warranty

- 1.1. Ensure that the project manual specifies requirement of a manufacturer's warranty for all white boards for a period of 24 years beyond the date of expiration of the performance assurance.
- 1.2. Ensure that the project manual specifies requirement of a manufacturer's warranty for all cork boards for a period nine (9) years beyond the date of expiration of the performance assurance.

### 2. Materials

- 2.1. For White boards specify facings of steel sheet with porcelain enamel finish for dry, water dampened, erasable markers and chalk.
- 2.2. Ensure white boards are suitable for use as projection screen and are unaffected by solvents and reagents.
- 2.3. Include with Communication boards, accessories as required. (Refer to DC350, Part 2, Section 2, Division 10).

### 3. Execution

- 3.1. Samples of communication boards to be submitted for approval.
- 3.2. For mounting height, extent and location in schools, refer to DC350, Part 2, Section 2, Division 10.
- 3.3. Where design incorporates mounting boards on slope to reduce glare, refer to requirements of Electrical Lighting.
- 3.4. Install to manufacturer's instruction, level and in true planes.

## Section 10 11 23 Tack Boards and Bulletin Boards

1. Material
  - 1.1. 1/8" thick natural cork, laminated to 3/8" fibreboard backing.
  - 1.2. Include with boards, accessories as required. Refer to DC350, Part 2, Section 2, Division 10.
2. Execution
  - 2.1. For Mounting at height, extent and location, refer to DC350, Part 2, Section 2, Division 10.
  - 2.2. Install to manufacturer's instruction, level and in true planes.

## Section 10 14 00 Signage

### 1. Exterior

- 1.1. Where Exterior Signage is incorporated into design, ensure that it is graphically designed and conforms with applicable local by-laws and regulations as well as the requirements of Emergency Measures Organization Standards.
- 1.2. Use channel letter type unless specified otherwise.
- 1.3. (Roadway Signs)
  - 1.3.1. Provide for signage to requirements of the Department of Transportation and Infrastructure Renewal and the local municipal authority. Identify and control traffic movement on site; including, but not limited to, sidewalks, bus entrances, car parking and service entrances.

### 2. Interior Signage

- 2.1. Include Interior Signage in design and specify, unless indicated otherwise, such that:
  - 2.1.1. Faces of colour acrylic sheet.
  - 2.1.2. Surface engraved.
  - 2.1.3. Contemporary letter style.
  - 2.1.4. Fixed mounting, with stainless steel screws.
  - 2.1.5. Number plates
    - 2.1.5.1. 3" high x length permitting 3 - 2" high numbers
  - 2.1.6. Name plates
    - 2.1.6.1. 3"high x 20" long
  - 2.1.7. Identify circulation systems such as:
    - 2.1.7.1. Vertical
    - 2.1.7.2. Horizontal
    - 2.1.7.3. Emergency
  - 2.1.8. Identification Devices
    - 2.1.8.1. Provide international symbol of access to CSA B651-18 indicating barrier - free accessibility for each, such designated, washroom in project.

2.1.8.2. Provide male and female pictograms for all washrooms and showers in the project.

2.1.8.3. Select Size, colour and style.

2.2. Execution

2.2.1. Name plates for each specialty room and area.

2.2.2. Each room to have a number plate.

2.2.3. All signage to be barrier free. Specify tactile identification is provided on all assembly, speciality rooms and support areas designated for public access. Ensure such signage is mounted at heights in accordance with barrier-free standards.

2.2.4. Signage to be located beside doorway as operation will support, non-obscured by door operation.

2.2.5. Room numbering system to facilitate consecutive numbering of rooms to assist in way finding.

2.2.6. Numbering system to matche the numbering system used on the Consultant's drawings.

## Section 10 21 13 Toilet Compartments

1. General:
  - 1.1. Toilet partitions
    - 1.1.1. For Student Washrooms (Building Support Services)
      - 1.1.1.1. Floor mounted water-resistant compartments and screens - plastic laminate with solid phenolic core.
      - 1.1.1.2. All fastenings shall have factory installed threaded inserts or through bolt connections including door hardware.
2. Materials:
  - 2.1. Stiles, Doors and Wall Posts: 3/4" thick, solidly fused plastic laminate with matte finish melamine surface coloured face sheets and black phenolic resin core integrally bonded. Self closing doors for barrier-free stalls.
  - 2.2. Panels: 1/2" thick, solidly fused plastic laminate with matte finish melamine surface coloured face sheets and black phenolic resin core integrally bonded.
  - 2.3. Laminated Plastic Sheets. to CAN3 A172-M79 (R1996), with solid colour pattern, satin finish.
  - 2.4. Core Material
    - 2.4.1. Black phenolic resin core, integrally bonded.
  - 2.5. Laminated Plastic Adhesive: adhesive to CSA O112 SERIES-M1977 (R2006) Series.
  - 2.6. Stainless Steel Sheet Metal: to ASTM A167-99(2009), Type 304 with satin finish.
  - 2.7. Fasteners: stainless-steel tamper-proof type screws and bolts.
  - 2.8. Sealer: Water resistant sealer or glue as recommended by laminate manufacturer.
  - 2.9. Headrails: clear anodized, extruded aluminum, sloped top, anti-grip design, satin finish.
  - 2.10. Pilaster shoe - one-piece stainless-steel 4" high, satin finish.
  - 2.11. Hardware:
    - 2.11.1. Hinges:
      - 2.11.1.1. Heavy duty, self-lubricating, nylon bushings.
      - 2.11.1.2. Material/Finish: stainless steel.

- 2.11.1.3. Swing: inward and outward.
  - 2.11.1.4. Return Movement: gravity.
  - 2.11.1.5. Adjustable to hold door open at any angle up to 90 deg.
  - 2.11.1.6. Emergency access
  - 2.11.2. Latch Set:
    - 2.11.2.1. Surface mounted combination latch, doorstop, chrome plated non-ferrous, stainless steel, emergency access feature.
  - 2.11.3. Wall and Connecting Brackets: stainless steel extrusion or casting.
  - 2.11.4. Coat Hook: combination hook and rubber door bumper, stainless steel.
  - 2.11.5. Door Pull: Barrier-free type suited for out swinging doors, stainless steel.
3. Execution:
- 3.1. Include reinforcing, anchorage and mounting devices required for the installation of each product.
  - 3.2. Fit joints and junctions between components tightly and in true planes, conceal and weld joints where possible.
  - 3.3. Fabricate products with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that Work will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.
4. Installation
- 4.1. Provide manufacturer's handling instructions, anchorage information, roughing-in dimensions, and templates for installation of Work of this Section.
  - 4.2. Install Work only as specified by manufacturer.
  - 4.3. Verify location and mounting heights of products with the Consultant before roughing-in or installation.
  - 4.4. Install Work plumb, level, straight, tight and secure to mounting surfaces, and centered between joints on masonry and tile walls.
  - 4.5. Attach accessories to walls with only:
    - 4.5.1. ½" long expansion shields in solid masonry or in concrete
    - 4.5.2. Toggle bolts in cells of hollow masonry units

- 4.5.3. Sheet metal screws into metal framing at metal stud partitions
- 4.5.4. Wood screws into wood framing
- 4.6. Use only fasteners that match material and finish of fastened Work where exposed to view.



**Section 10 21 16 Shower and Dressing Compartments**

1. Where Shower and Dressing Compartments are incorporated into design, specify such that they complement Plastic Laminate Toilet Compartments.

## Section 10 22 26 Operable Partitions

1. Quality Control
  - 1.1. Ensure installation of the operable partition is by factory-trained and manufacturer approved installer.
2. Reference Standards:
  - 2.1. ASTM E90-09(2016), Standard Method of Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - 2.2. ASTM E413-16, the standard by which the Sound Transmission Class is determined.
  - 2.3. ISO 140-3/Amd1:2004 Laboratory Measurement of Airborne Sound Insulation of Building Elements.
  - 2.4. ISO 717-1:2013, Rating of Sound Insulation in Buildings and of Building Elements: Airborne Sound Insulation in Buildings and of Interior Building Elements.
  - 2.5. ULC 102.2:2018 Surface Burning Characteristics of Building Materials and Assemblies.

## Section 10 28 00 Toilet, Bath and Laundry Accessories

### 1. Materials

- 1.1. Where Toilet and Bath Accessories are incorporated into design, specify such that material and products specified meet or exceed "Bobrick" standards. Refer to DC350, Part 2, Section 2, Division 10.
- 1.2. Wherever sinks, showers, or similar fixtures are provided in a room, at least one of each shall be barrier-free.
- 1.3. Unspecified materials which form a part of complete assemblies shall be of manufacturer's standard.
- 1.4. Paper Towel Dispenser
  - 1.4.1. Product: Paper towel holder to hold 8" wide x 6" paper towel roll.
  - 1.4.2. Location: one in each washroom
- 1.5. Feminine Napkin Dispenser:
  - 1.5.1. Stainless steel semi-recessed unit including roughing in frame, minimum capacity 15 napkins and 20 tampons, 10 cents operation, key locked, continuous hinge front panel.
  - 1.5.2. Location: one in each women's washroom.
- 1.6. Feminine Napkin Disposal Bin
  - 1.6.1. Stainless steel, semi-recessed unit including rough-in frame, continuous hinged door, self closing, embossed with "napkin disposal", removable stainless-steel receptacles fitted with spring clip for deodorizer block.
  - 1.6.2. 1 in each female toilet compartment
- 1.7. Toilet Tissue Dispensers:
  - 1.7.1. Construction: 304 Stainless Steel
  - 1.7.2. Finish: Satin
  - 1.7.3. Mounting: Surface
  - 1.7.4. Location: one at each toilet
- 1.8. Grab Bars:
  - 1.8.1. Material: Tube, 1-1/4" dia., 304 stainless steel
  - 1.8.2. Flanges: 3" dia. concealed
  - 1.8.3. Finish: Peened grip, polished ends

- 1.8.4. Amount: 2 at each accessible urinal, water closet and shower, mounted in locations and to heights as per the requirements of the Nova Scotia Building Code and the CSA B651-18 standard for Accessible design for the Built Environment.
- 1.9. Shower Curtain Rods:
  - 1.9.1. Rod: 1 1/4 diameter, 18-gauge, type 304 stainless steel complete with 2 1/2" square end flanges.
  - 1.9.2. Location: Two each in shower stall
- 1.10. Shower Curtains:
  - 1.10.1. Material: Opaque, matte white vinyl, 2 mm thick complete with nickel plated brass grommets along top every 6" and stainless-steel curtain hooks.
  - 1.10.2. Location: two each in each shower stall.
- 1.11. Shower Seats:
  - 1.11.1. Material: 4 wood grain phenolic slats 5/16" x 3"
  - 1.11.2. Type: 304 stainless steel construction
  - 1.11.3. Mounting: Surface mounted, 18" from top of seat to floor
  - 1.11.4. Location: Two each in each barrier-free shower stall in rooms. One each in all other showers.
- 1.12. Tilt Mirrors:
  - 1.12.1. Frame: Type 304 stainless steel, satin finish.
  - 1.12.2. Glass: 1/4" No. 1 Quality float/plate glass mirror.
  - 1.12.3. Mounting: Surface mounted 44" from bottom of mirror to floor, concealed fasteners.
  - 1.12.4. Location: One each over each barrier-free Lavatory.
- 1.13. Frame Mirrors at sinks:
  - 1.13.1. Frame: One piece roll formed, type 304 stainless steel channel with satin finish
  - 1.13.2. Glass: 1/4" No. 1 quality float/plate glass mirror
  - 1.13.3. Mounting: Surface mounted on concealed wall hanger and secured with theft-resistant locking screws. Bottom of mirror to floor - 38"
  - 1.13.4. Size: 18" x 24" security mirror.
  - 1.13.5. Location: for every sink except barrier-free sinks

1.14. Full Length Frame Mirror:

- 1.14.1. Frame: One piece roll formed, type 304 stainless steel channel with satin finish
- 1.14.2. Glass: 1/4" No. 1 Quality float/plate glass mirror.
- 1.14.3. Mounting: Surface mounted on concealed wall hanger and secured with theft-resistant locking screws. Bottom of mirror to floor - 12"
- 1.14.4. Size: 24" x 72", B290 2472
- 1.14.5. Location: one in each dressing room

1.15. Soap Dish:

- 1.15.1. Mounting: Recessed with anchor lugs
- 1.15.2. Construction: Heavy duty stainless steel, satin finish
- 1.15.3. Location: One in each shower stall

1.16. Towel Bars:

- 1.16.1. Bar: 18-gauge, type 304, stainless steel satin finish, 1" diameter x 18" long
- 1.16.2. Mounting: Concealed mounting plate
- 1.16.3. Location: One in each dressing compartment of shower stalls. One outside each gym instructor's shower

1.17. Robe Hooks:

- 1.17.1. Location: One in each dressing compartment of shower stalls. One on inside of each gym instructors washroom door
- 1.17.2. Construction: One piece brass casting with satin nickel-plated finish
- 1.17.3. Mounting: Locks to wall plate for theft proof mounting

1.18. Custodial Accessories:

- 1.18.1. Construction: 18 ga. type 304, stainless steel, satin finish
- 1.18.2. Shelf with mop holders and rag hooks; 4 holders, 3 hooks 36" length
- 1.18.3. Location: one each in janitor room

1.19. Waste Receptacle

- 1.19.1. Product: Swing top receptacle suitable for institutional use
- 1.19.2. Location: one in each washroom

2. Fabrication

- 2.1. Include reinforcing, anchorage and mounting devices required for the installation of each product.
- 2.2. Fit joints and junctions between components tightly and in true planes, conceal and weld joints where possible.
- 2.3. Fabricate products with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that Work will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

3. Installation

- 3.1. Provide manufacturer's handling instructions, anchorage information, roughing-in dimensions, and templates for installation of Work of this Section.
- 3.2. Install Work only as specified by manufacturer.
- 3.3. Verify location and mounting heights of products with Consultant before roughing-in or installation.
- 3.4. Install Work plumb, level, straight, tight and secure to mounting surfaces, and centered between joints on masonry and tile walls.
- 3.5. Attach accessories to walls with only:
  - 3.5.1. ½" long expansion shields in solid masonry or in concrete
  - 3.5.2. Toggle bolts in cells of hollow masonry units
  - 3.5.3. Sheet metal screws into metal framing at metal stud partitions
  - 3.5.4. Wood screws into wood framing.
- 3.6. Use only fasteners that match material and finish of fastened Work where exposed to view.
- 3.7. Ensure that grab bars are installed to withstand a minimum downward force of 900 lbs. per grab bar.

**Section 10 44 00 Fire Protection Specialties**

1. General
  - 1.1. Include Fire Extinguishers, Cabinets, and Accessories in design and specify such that they meet or exceed all applicable code requirements including but not limited to, Nova Scotia Building Code (N.S. Reg. 44/2019) requirements.
2. Products
  - 2.1. Fire Extinguishers
    - 2.1.1. Provide to NFPA requirements.

**Section 10 51 00 Lockers**

1. Where lockers are required in the design, ensure there are sufficient barrier-free types included.
2. Size and design to suit functionality of the project.
3. Unless specified otherwise:
  - 3.1. Top: sloping, 20ga steel.
  - 3.2. Accessories: Hat shelf, 2 Coat hooks.
  - 3.3. Factory assembled.
  - 3.4. Doors: double pan design, 16ga outer panel and 24ga inner panel, complete with reinforcing 2 bars per door.
  - 3.5. Frame: 16ga steel.
  - 3.6. Sides and back: 24ga steel.



**Section 10 56 00 Storage Shelving**

1. Where Metal Storage Shelving is incorporated into design, refer to DC350, Part 2, Section Division 05, 05 50 00 Metal Fabrications.

## **Section 10 57 00 Wardrobe and Closet Specialties**

1. Wardrobe Mounting Heights
  - 1.1. Where Wardrobe and Closet Specialties are incorporated into design, refer to DC350, Part 2, Section 2, Division 10.
2. Where corridor storage requiring clothing hangers are incorporated into design, specify such that the closed loop hanger occur at a rate of four closed loop hanger per foot of corridor storage.

**Section 10 73 00 Protective Covers**

1. Provide canopy protection for all entrance areas.

## Section 10 75 00 Flagpoles

### 1. Materials

#### 1.1. Where Flagpoles are incorporated into design, specify:

- 1.1.1. Cone-tapered, seamless, extruded aluminum tubing to Aluminum Association Alloy AA 6063-T5, Satin Finish.
- 1.1.2. Length: 30'-0" long, including base mount brackets, anchorage and fittings.
- 1.1.3. Uniform straight-line tapered section above the cylindrical butt section; tapered 1" in 5'6" of run.
- 1.1.4. Provide internal splicing, self-aligning sleeve of aluminum as flagpole, snug fitting, watertight joints.
- 1.1.5. Finial
  - 1.1.5.1. 6" diameter ball of 3/16" minimum thickness, aluminum anodized, colour gold.
- 1.1.6. Truck Assembly
  - 1.1.6.1. Stainless steel ball bearing, non-fouling, revolving double truck assembly, finish matching flagpole.
- 1.1.7. Halyard
  - 1.1.7.1. Internal type, braided nylon, with steel or bronze core; complete with stainless steel retaining loop and weights for internal halyard.
- 1.1.8. Swivel Snaps
  - 1.1.8.1. Provide 2 per halyard
  - 1.1.8.2. Aluminum with neoprene or vinyl covers.
- 1.1.9. Cleat Box
  - 1.1.9.1. Lockable
  - 1.1.9.2. One per cleat
  - 1.1.9.3. Cast aluminum, finish matching flagpole, complete with hasp for padlock, hinged cover, and tamper-proof screws.
  - 1.1.9.4. Clear anodized finish.

#### 2. Flag provided by Minister.

**END**

## DIVISION 11 - EQUIPMENT

### Section 11 00 00 Equipment - General

1. Information relates to Department technical requirements regarding maintenance equipment, security and vault equipment, library equipment, theater and stage equipment, instrumental equipment, audio-visual equipment, vehicle service equipment, parking control equipment, loading dock equipment, solid waste handling equipment, detention equipment, water supply and treatment equipment, fluid waste treatment and disposal equipment, food service equipment, residential equipment, athletic, recreational, and therapeutic equipment, laboratory equipment, office equipment, exhibit equipment, and the like.
2. Ensure equipment included in the contract documents, or supplied by the Client Department, have been provided with all necessary spaces, mechanical and electrical services and other support to accommodate same.
3. Warranty
  - 3.1. Ensure that the project manual specifies requirement of a manufacturer's warranty for all commercial kitchen refrigeration equipment compressors for a period of four (4) years beyond the date of expiration of the performance assurance.
4. All installed equipment shall be CSA approved.
5. For Equipment list, refer to DC350, Part 2, Section 2, Division 11, or project program.
6. Fabrication
  - 6.1. Ensure work is fabricated square, true, straight, fitting conditions and the program.
  - 6.2. Specify equipment fabricated from stainless steel, unless noted otherwise.
  - 6.3. Ensure equipment is fitted and shop-assembled, ready for erection where possible.
  - 6.4. Ensure equipment is deburred and has smooth edges.
  - 6.5. Ensure counter tops, tabletops, drain boards, tray rails, and shelving are one continuous piece, where length is 10 feet or less. For equipment over 10 feet, ensure stainless steel sections are welded, including field joints.

- 6.6. Welding
  - 6.6.1. Ensure welding is sound, non-porous, and free from imperfections. Ensure welds are continuous, except for spot welds or if indicated otherwise.
  - 6.6.2. Ensure color and corrosion resistance of weld matches surround material. Ensure welding or finishing process does not impair the corrosion resistance of the finished equipment.
  - 6.6.3. Ensure spot welds are a minimum 1/8" diameter and have full penetration.
  - 6.6.4. Ensure exposed welds are ground smooth and polished matching surround material. Ensure other welds are ground smooth.
- 6.7. Ensure equipment is installed in accordance with manufacturer's printed instructions, co-ordinated with appropriate mechanical and electrical work.
- 6.8. Game Lines
  - 6.8.1. Game line layouts for specific gymnasiums are available from DPW staff.
  - 6.8.2. Co-ordinate installation of gymnasium equipment in relation to such layouts.
  - 6.8.3. Discuss with and receive Department approval for any deviation from such approved layouts.

**Section 11 65 00 Athletic and Recreational Equipment**

1. In-Floor Accessories

- 1.1. Place-in-floor accessories after floor surface installation but before installation of game lines.
- 1.2. Place-in-floor accessories penetrating concrete slab after concrete has cured a minimum of 56 calendar days.

**END**

## **DIVISION 12 - FURNISHINGS**

### **Section 12 00 00 Furnishings - General**

1. Information relates to Department technical requirements regarding fabrics, art, manufactured casework, furnishings and accessories, multiple seating, systems furniture, interior plants and planters, furnishing restoration and repair, and the like.



**Section 12 20 00 Window Treatment**

1. All exterior windows and interior borrowed light partitions to have “room darkening curtains and hardware”.

**Section 12 30 00    Manufactured Casework**

1. Where Manufactured Casework is incorporated into design, refer to applicable section of DC350, Part 2, Section 2, Division 12, for specialties of casework - extent, location, locking, and the like.
2. Except for some kitchen and equipment list items, casework is defined in DC350, Part 1, Section 2, Division 06 as woodwork.
3. Dirty areas” of Kitchen cabinets (dishwashing) to be stainless steel.

## Section 12 36 00 Countertops and Backsplashes

### 1. Plastic Laminate

- 1.1. Commercial grade to specified requirements of CSA A172-M.
- 1.2. Approved manufacturer's:
  - 1.2.1. Nevamar
  - 1.2.2. Formica
  - 1.2.3. Arborite
  - 1.2.4. Pionite
  - 1.2.5. or approved equal
- 1.3. Material:
  - 1.3.1. For post-forming: 0.030" (0.75 mm) thick
  - 1.3.2. For flat work : minimum 0.045 (1.15mm) thick, commercial grade.
- 1.4. Finish Suede; colours chosen by Consultant from manufacturer's full range. No more than 4 colors per job.
- 1.5. Adhesives and Sealers: tested for acceptable VOC emissions to meet applicable EcoLogo certification or in accordance with ASTM D2832-92(2016) and the applicable ASTM standard for determining the composition of the volatile fraction.
  - 1.5.1. Provide postformed countertops with integral backsplashes of high pressure laminated plastic bonded to substrate, unless otherwise specified in project specific brief, or as approved in writing by DPW.
  - 1.5.2. Edges and corners rounded.
  - 1.5.3. Construction:
    - 1.5.3.1. Layout laminate pieces in minimum 12' long pieces, and with joints at least 24" from sink cutouts. Ensure hairline cracks along joints.
    - 1.5.3.2. Laminate to be fully supported by core material.
    - 1.5.3.3. Adhere plastic laminate to core material in strict accordance with adhesive manufacturer's written instructions. Apply adhesive over entire surface.
    - 1.5.3.4. Expose edges of flat work are to be moderately and uniformly beveled (200 off vertical)

- 1.5.3.5. All exposed edges of core material are to be faced with plastic laminate.
- 1.5.3.6. At joints, use draw bolts and splines, spaced at maximum 16", and so as to produce hairline crack along joints.

**Section 12 48 00 Rugs and Mats**

1. Incorporate Foot Grills, Floor Mats and Frames into design, as appropriate, at each exterior entrance.

**END**

**DIVISION 13 - SPECIAL CONSTRUCTION**

**Section 13 00 00 Special Construction - General**

1. Information relates to DC350 technical requirements regarding sound/vibration and seismic control.

**Section 13 48 00 Sound Vibration and Seismic Control**

1. The goal of the noise and vibration control shall be to ensure that mechanical equipment and systems operate at the lowest sound and vibration level consistent with the functional requirements of the project.
2. Moving machinery shall be set on foundations/housekeeping pads isolated from the structure to minimize the transmission of noise and vibration.
3. Locate heavy reciprocating machinery on the lowest level of the building. Provide specially designed structural base/housekeeping pad for equipment. Carefully consider the loading of the equipment loading on the foundation and supporting structure.
4. Provide careful attention to the isolation design of equipment and systems.
  - 4.1. Flexible pipe and duct connections shall be installed at all pipe and duct connections to vibration isolated equipment (not required if equipment internally isolated). Three (3) roll grooved joints (see Section 22 05 00) may be used in lieu of flexible pipe connectors. See Flexible Connections in Ductwork Accessories section for further information.
  - 4.2. All fans and pumps shall be isolated from the building structure.
5. Isolate the following equipment types from the building structure by means of spring isolators and an inertia base: AHU units (not required if internally isolated), base mounted pumps, air compressors over 5 hp, and chillers. Other types of isolation (in accordance with manufacturer's recommendations) may be considered but will be allowed only with written permission from DPW.
6. Isolate air compressors up to and including 5 hp from the building structure by means of spring isolators.
7. Electrical connections to vibration isolated equipment shall be flexible.
8. Locate isolators for equipment with bases on the sides of the base which are parallel to the equipment shaft.

**END**

## DIVISION 14 - CONVEYING EQUIPMENT

### Section 14 00 00 Conveying Equipment - General

1. Information relates to technical requirements for dumbwaiters, elevators, lifts, , and the like.
  - 1.1. All projects which include elevator controls upgrades or installation of a new elevator must provide for the requirement that all systems specified and installed are to be non-proprietary in function and that the warranty work and system access codes are to be turned over to a provincial wide contractor in charge of elevator maintenance at the time of the expiration of the warranty period.
2. Warranty
  - 2.1. Ensure that the project manual specifies requirement of a full warranty covering materials, performance and workmanship for elevators and the like for a period of one (1) year from the date of substantial performance.
  - 2.2. An extended warranty beyond the first year may be included according to the specific project requirements.
3. Maintenance
  - 3.1. Provide for a maintenance and service agreement for the equipment which meets the requirements of the warranty, including but not limited to routine maintenance, parts, labour, and 24 hour call back services, for a period of one (1) year from the date of substantial performance of the work.
  - 3.2. Service Mechanic responsible for providing call back service responses must have a regional certified service provider within 250 km radius of the Project Site. Call back individual must also have all proper tools, equipment, and proper spare parts readily available to effectively provide service and repairs.
  - 3.3. A Maintenance Bond for elevator service during and after the warranty period may be required. Refer to a IAH Division 0 and Division 1 standardized sections for details as required per project, unless the elevator work will be assigned to a pre-existing Provincial Maintenance Contract. Provide IAH dollar amount to dedicate to the Bond amount required.



## Section 14 20 00 Elevators

For new construction and additions of more than one-story, provide a minimum one elevator as required. Discuss need for key operation, live system monitoring, performance, accessories, and usage with Department's representative.

### 1. Elevator Systems General:

#### 1.1 Reference Standards:

1.1.1 Do elevator work to CSA B44 PACKAGE, 2002, local codes and regulations except where specified otherwise.

1.1.2 Nova Scotia Elevators and Lifts Act and Nova Scotia Elevators and Lifts General Regulations, current editions.

1.1.3 In accordance with the Nova Scotia Elevators and Lifts Act, no person shall construct, install, repair, maintain, service, inspect, examine, or test and elevating device unless that person:

1.1.3.1 Holds a certificate of competency issued under the Nova Scotia Elevators and Lifts Act, or

1.1.3.2 Is a mechanic in training under the supervision of a person who holds a certificate of competency under the NS Elevators and Lifts Act, 2002, c. 4, s. 5

1.2 Provide one elevator in each facility of more than one story. Ensure the elevator is:

1.2.1 Sized: to accommodate stretcher, sized as per NBCC, current edition.

1.2.2 Rated load: minimum 2500 lbs. exclusive of complete car and plunger

1.2.3 Key operated.

1.2.3.1 Located ensuring ease of supervision and community use, and proximity and clear visibility from the main entrance and administration offices and form an integral element of the main lobby.

1.2.3.2 Elevator must be a full-size elevator, not a wheelchair lift.

NOTE: hydraulic elevators use an electronic pump that pushes oil into a cylinder where the pressure is increased, pushing a piston and causing the elevator to

rise. A traction elevator, on the other hand, uses a system of cables, pulleys, and counterweights to lift the cab. Select appropriate elevator type for facility and discuss options with IAH Representative.

### 1.3 Hydraulic Elevators

#### 1.3.1 Description of Systems

1.3.1.1 Travel: as required

1.3.1.2 Openings: as required

1.3.1.3 Speed: 100 f.p.m. in up and down direction with rated load and with maximum speed. Variation +/- 5% no load to rated load.

### 1.4 Traction Elevators

1.4.1 Select traction elevators for use in mid to high-rise facilities.

1.4.2 Discuss with Departmental Representative, proper traction elevator choice, dependent on budget, use, function, and facility operation. These include:

#### 1.4.2.1 Traction Elevator

1.4.2.1.1 Description/function/layout/purpose/**smoothness of ride/location of controls/machine room**

#### 1.4.2.2 Geared Traction Elevator

1.4.2.2.1 Description/function/layout/purpose/ smoothness of ride/location of controls/machine room

#### 1.4.2.3 Gearless Traction Elevator

1.4.2.3.1 Description/function/layout/purpose/ smoothness of ride/location of controls/machine room

1.4.3 Travel: as required

1.4.4 Openings: as required

1.4.5 Speed: 150-500 f.p.m. in up and down direction with rated load and with maximum speed. Variation +/- 5% no load to rated load.

1.4.6 Traction elevators can be configured with or without machine rooms. Discuss options, costs, and functions with IAH Representative.

## 2. Two-Stop Automatic Operation

### 2.1 Include two-stop automatic elevator operation, as follows:

2.1.1 Provide flush mounted operating device in car with stainless steel faceplate containing push buttons marked to correspond with two landings served, emergency stop switch, light switch arranged for restricted operation, door open button and alarm button.

2.1.2 Arrange operation so that momentary pressure of car button for opposite terminal dispatches car to the terminal.

2.1.3 Allow call registered by momentary pressure landing buttons at any time to remain registered until car stops in response to that call at that landing.

2.1.4 If hoistway door is not opened within short interval after car has stopped at terminal, arrange car to respond to call from other terminal.

#### 2.1.4.1 Security Operation

##### 2.1.4.1.1 Include a security feature to operate as follows:

2.1.4.1.1.1 Include in each hall pushbutton station a spring return keyed switch and a normal pushbutton.

2.1.4.1.1.2 At the upper floor include a two-position keyed switch (keyed differently) with the key removable in the "On" and "Off" position.

2.1.4.1.1.3 When the system is turned "On" it will be necessary at either floor to use the spring return key to place a hall call. When the system is turned "Off" the hall push buttons will operate normally; without requiring the use of the key switches.

2.1.4.1.1.4 Card Readers are acceptable if required to suit the program provided. Discuss functionality with the IAH Representative concerning accessibility, security and general access permissions.

- 2.1.4.2 Car Stall Protective Circuit
  - 2.1.4.2.1 Automatically return car to bottom landing and open power operated doors if car should stall as result of relay failure, valve failure or low oil in system while ascending. Restore service by opening and reclosing main line switch.
- 2.1.4.3 Emergency Operation
  - 2.1.4.3.1 Include means to automatically return the elevator to the lowest landing upon failure of normal power supply. Include door operation.
  - 2.1.4.3.2 Include back-up battery operation to permit elevator to return to nearest landing in buildings without back-up generator.
- 2.1.4.4 Two-Way Leveling
  - 2.1.4.4.1 Include automatic two-way Leveling device. Approach landing stops at reduced speed from either direction of travel.
  - 2.1.4.4.2 Level with accuracy of 1/4" under varying load conditions.
- 2.1.4.5 Performance
  - 2.1.4.5.1 Design and adjust equipment as follows:
    - 2.1.4.5.1.1 Provide smooth acceleration and deceleration of car without perceptible steps, so adjusted as not to cause passenger discomfort.
- 2.1.4.6 Accessibility Considerations:
  - 2.1.4.6.1 Comply with CSA B44 PACKAGE, 2002, CSA B651-18, and the following:
    - 2.1.4.6.1.1 Locate upper most button in elevator cab control panel and centre-line of telephone instrument not more than 4'-6" above floor level.
    - 2.1.4.6.1.2 Furnish 2" wide flat bar x 1/4" thick solid stainless-steel handrails on the side and rear walls of car with ends returned close to panels.

2.1.4.6.1.3 Sound audible soft-toned signal in car when car is stopping at a floor.

2.1.4.6.1.4 Provide car riding lanterns with gongs which sound once for "up" stops and twice for "down" stops.

2.1.4.6.1.5 Provide Arabic numerals 5/8" in height raised 1/32" immediately to left of floor buttons.

#### 2.1.4.7 Components

2.1.4.7.1 Use major elevator components from standard product line of one manufacturer unless otherwise approved.

#### 2.1.4.8 Emergency Lighting

2.1.4.8.1 Include emergency lighting in car as follows:

2.1.4.8.1.1 Use battery operated emergency lighting equipment, to CSA C22.2 No. 141-15, to provide general illumination and 10 lux minimum illumination in car at operating panels and telephone cabinet for four hours minimum.

2.1.4.8.1.2 Include means for convenient manual operation and testing of each unit from within car.

2.1.4.8.1.3 Include means of containing any leakage or spillage of electrolyte.

#### 2.1.4.9 Passenger Car Enclosure

2.1.4.9.1 Provide low voltage LED lighting in elevator cab ceilings and elevator controls.

2.1.4.9.2 LED ceiling lights to be recessed.

2.1.4.9.3 LED ceiling lighting to be downlighting configured.

2.1.4.9.4 Fabricate front return panels, soffit and entrance columns of seamless stainless steel panel.

2.1.4.9.5 Provide pad hooks if no service elevator available on site or included in the scope of work.

- 2.1.4.9.6 Provide Emergency call pushbutton inside elevator cab, connected to 24-hour monitoring system in case of emergency.
- 2.1.4.9.7 Fabricate side and rear cab walls of one-piece wood core faced in plastic laminate.
- 2.1.4.9.8 Use bolts fitted with washers and lock washers and fabric separators, if necessary, to assemble and ensure entire structure to operate entirely free from squeaks and metallic sounds.
- 2.1.4.9.9 Provide 7'-4" clear heights under fixed hung car ceiling.
- 2.1.4.9.10 Provide clear car entrance height of 7'-0".
- 2.1.4.9.11 Finish car doors stainless steel typical at interior elevator. Hall side finish stainless steel or painted steel if approved by Departmental Representative.
- 2.1.4.9.12 Furnish stainless steel license holder in elevator car to suit certificate issued by authority having jurisdiction. Design holder with hidden or tamper proof fastening.
- 2.1.4.10 Door Protective Device
  - 2.1.4.10.1 Include door protective device extending full height of clear opening and projecting beyond leading edge of each door panel.
  - 2.1.4.10.2 Arrange to retract noiselessly at both limits of travel.
  - 2.1.4.10.3 Design and adjust to cause doors to stop and reopen before doors contact object or person.
  - 2.1.4.10.4 Should this device touch person or object while car door is closing, return car and hoistway doors to open position.
- 2.1.4.11 Light Ray Device
  - 2.1.4.11.1 Include additional door protection by means of an infra-red multi-beam array of up to 50 beams projected across elevator car entrance.
  - 2.1.4.11.2 After stop is made, hold doors open for predetermined adjustable interval, unless closing is initiated sooner by registration of car call.

2.1.4.12 Fire Rated Entrances

2.1.4.12.1 Provide fire protection rated elevator closures, produced under label service program of ULC or other agency acceptable to DFC and regional authorities having jurisdiction.

2.1.4.12.2 Affix ULC or other acceptable agency label to elevator closures.

2.1.4.13 Field Quality Control

2.1.4.13.1 Perform and meet tests required by CSA B44 PACKAGE, 2002.

2.1.4.13.2 Supply instruments and carry out additional specified tests.

2.1.4.13.3 Furnish test and approval certificates issued by jurisdictional authorities.

2.1.4.13.4 Provide 2 weeks' written notice of date and time of tests.

**Section 14 40 00 Lifts**

1. Wheelchair Lifts / Vertical Platform Lift
  - 1.1. Provide a commercial quality, barrier-free lift, where required in the design.
  - 1.2. Discuss need for key operation, supervision, performance, accessories, and usage with Department's Representative.
  - 1.3. Where pit depth or roof penetration, or both, are restricted, use of a Limited Use/Limited Application (LU/LA) elevator/lift may be permitted. Typically, 'limitations' are 25' of travel; 30 fpm; 1400lb capacity and 18 sq. ft. of floor space. NOTE: These do not meet the stretcher size requirement and must be permitted for use, in writing, by IAH Departmental Representative. LU/LA elevators must be equipped with battery back-up system and should meet the function and finishes of a standard elevator.
  - 1.4. Portable lifts may be utilized where space is not sufficient during a renovation. Discuss options and functional requirements and obtain written approval for use in design, from Departmental Representative.
  - 1.5. Also, refer to 14 20 00 Elevators.

**END**



## **DIVISION 20 – GENERAL MECHANICAL**

### **20 05 00 – Common Work Results for Mechanical**

#### **1. General Mechanical Requirements**

- 1.1 Installations shall provide for safe maintenance procedures for maintenance personnel with minimum contact with the general population along with minimum disruption of services.
- 1.2 Equipment and materials shall be new and CSA certified for the application. Work and materials shall be in accordance with all authorities having jurisdiction, whichever is more stringent.
- 1.3 Supply tools, equipment and personnel to demonstrate and instruct building operating and maintenance personnel in operating, adjusting, troubleshooting and servicing of all systems and equipment. In addition to where training is specified elsewhere in Divisions 20-29, factory trained personnel shall provide on-site instruction in operation and maintenance as follows:
  - 1.3.1 Air Distribution Systems - min. 8 hours pre-substantial, min. 2 hours during warranty
  - 1.3.2 Dust Collection System - min. 4 hours pre-substantial, min. 4 hours during warranty
  - 1.3.3 Heating Systems - min. 4 hours pre-substantial, min. 2 hours during warranty
  - 1.3.4 Boilers - min. 4 hours pre-substantial, min. 2 hours during warranty
  - 1.3.5 Plumbing Systems - min. 4 hours pre-substantial, min. 2 hours during warranty
  - 1.3.6 Fire Protection Systems - min.4 hours pre-substantial, min 2 hours during warranty
  - 1.3.7 Control Systems - min. 24 hours (min. of 3 sessions a minimum of 30 days apart)
- 1.4 Complete operations manuals and record drawings for all equipment and systems shall be provided by the contractor.
- 1.5 Mechanical design engineer shall coordinate with the architect to ensure designated fire rated walls and/or partitions have not been compromised by the mechanical systems.

- 1.6 All electrical equipment supplied as part of mechanical equipment packages (e.g. motors/starters part of a fan, air handling unit or pump package) shall meet the requirements of all Electrical specifications of the DC350.
  - 1.7 Provide spare parts as follows:
    - 1.7.1 One set of belts for each piece of machinery.
    - 1.7.2 One set of filters for each filter bank.
    - 1.7.3 One glass for each gauge glass.
    - 1.7.4 One set of packing seals for each pump.
    - 1.7.5 Two pressure gauges and two thermometers for each type and range used on the project.
    - 1.7.6 Enzymatic for grease interceptors.
    - 1.7.7 Keys for vandal resistant outlets.
  - 1.8 Provide one set of tools required to service equipment as recommended by the manufacturers. Also furnish one grease gun with adapters to suit the various types of greases and grease fittings.
  - 1.9 All electrical components of mechanical equipment are to be rated 75 degrees Celsius as a minimum.
  - 1.10 Refer to Section 07 90 00 - Joint Protection for sealant requirements for joints and penetrations in slab-on-grade, to protect from radon infiltration.
2. System Selection and Design Criteria
- 2.1. Mechanical systems shall:
    - 2.1.1. Be compatible with architectural, structural, electrical and other projects systems.
    - 2.1.2. Be simple, proven systems selected to provide maximum reliability and maintainability with consideration for the availability of parts and service.
    - 2.1.3. All mechanical systems shall be designed to be energy-efficient and to minimize owning, operating and maintenance costs for both summer and winter load requirements. Analyze these life cycle costs when evaluating system and equipment alternatives.
    - 2.1.4. Use a minimum amount of new energy consistent with required performance standards.
    - 2.1.5. Be installed with adequate space for proper maintenance. See "Accessibility for Operation and Maintenance".

- 2.1.6. Have consolidated layouts using minimum space consistent with maintenance and servicing requirements.
- 2.1.7. Have adequate provisions for testing, adjusting and balancing (TAB) and all other phases of commissioning.
- 2.1.8. Have space heating system independent of air distribution system. Exception: Hydronic reheat coils are permitted in ductwork to Small Work Rooms in schools.
- 2.1.9. Have accessible distribution runs allowing inexpensive alterations.
- 2.1.10. Be fail-safe with all equipment of a quality consistent with anticipated building life expectancy and/or required reliability of service.
- 2.1.11. Professional judgment shall be used in the application of these criteria with respect to economy, safety, and legal aspects.

### 3. Layouts of Mechanical Systems

- 3.1. All piping, ducting and other services, except gas piping and fuel oil lines, shall be concealed in ceilings, chases, shafts, furred spaces or partitions. This shall not apply in boiler rooms, chiller rooms, mechanical equipment rooms, basements or storage spaces not occupied by personnel. Also, run pipe and duct mains in corridors rather than above normally occupied rooms. Exceptions may be permitted in exposed ceiling spaces of cafeterias, gymnasiums and libraries with written permission from DPW.
- 3.2. Exposed will mean "not concealed". "Concealed" shall include mechanical services in ceiling spaces, trenches, chases, shafts, furred spaces or partitions. Services in tunnels are not considered to be concealed.
- 3.3. Seal all voids and openings and provide fire-stopping at fire rated walls and floors. All pipe penetrations of masonry walls and floors are to be sleeved with 16 gauge metal. Pipe sleeves shall be 12.7mm (1/2") larger in diameter than the insulated pipe. Fill all voids between sleeve material and pipe. Insulation shall be continuous through walls and floors. Both sides of wall must be sealed
  - 3.3.1. Where pipes or ducts pass through non fire-rated walls, floors, and partitions seal openings between pipes, ducts and the construction and make air-tight (smoke and/or acoustic seal) by applying appropriate insulation and caulking compound. Both sides of the wall must be sealed.
  - 3.3.2. Where pipes or ducts pass through fire-rated walls, floors and partitions maintain fire rating integrity. See also Ductwork section. Both sides of the wall must be sealed.

- 3.4. Unless otherwise specified, terminate sleeves flush at walls and ceilings. Slabs in potentially wet areas (e.g. mechanical rooms, kitchens, laboratories) are to be sleeved with Schedule 40 pipe extending 25mm (1") above the finished floor. This does not apply to concrete floors on grade.
  - 3.5. Piping and ductwork shall not be installed in any space used as an electrical switchgear or transformer room or electrical closet, nor communication rooms or closets, except if required to service the space.
  - 3.6. Piping or ductwork installed above motor control centres or surface mounted panel boards is discouraged. If no other routing is possible, maintain a minimum 61cm (24") clearance, with all piping to have a drip tray installed underneath.
  - 3.7. Water and waste pipes shall not be installed in exterior walls.
  - 3.8. Pipes, ducts and other utilities shall not be embedded in fireproofing or any column or other structural member. Neither shall they run between the fireproofing and the structural member so protected.
  - 3.9. Layouts shall be fully coordinated with all other disciplines, trades and sub-trades.
  - 3.10. The number of openings through waterproof membranes shall be kept to an absolute minimum. Openings through waterproof membranes subject to hydrostatic pressures shall be fully coordinated with structural designs.
4. Spatial Considerations for Mechanical Equipment
    - 4.1. The allocation of space for boilers, chillers, mechanical equipment and distribution systems shall comply with the requirements of this section.
    - 4.2. The number and locations of mechanical equipment rooms shall be determined by project requirements.
    - 4.3. Locate all mechanical equipment, including but not limited to air handling (HVAC) units, boilers, chillers, etc. in mechanical rooms or mechanical penthouses.
    - 4.4. All flammable or combustible materials not directly related to the furnace or boiler shall be kept and handled in separate rooms.
    - 4.5. Boiler and Chiller Rooms
      - 4.5.1. Boiler rooms shall be separate from mechanical equipment rooms containing air handling equipment, so as to eliminate any possibility of fumes from combustion equipment entering HVAC systems.
      - 4.5.2. Consideration shall be given to providing a separate room housing both boilers and chillers. This will reduce the construction costs to

satisfy code requirements for fire separations between the boiler and/or chiller rooms and the remainder of the building.

4.6. Air Handling Equipment Rooms/Rooftop Mechanical Equipment

4.6.1. Refer to Ventilation Design Considerations below.

4.7. Sizes

4.7.1. In determining sizes of boiler rooms, chiller rooms and mechanical equipment rooms, consideration shall include, but not necessarily be limited to, minimum requirements for installation, maintenance, servicing, removal and replacement of mechanical equipment. See also Accessibility for Operation and Maintenance, below.

4.8. Some of the criteria which will affect consideration of locations include, but are not necessarily limited to, the following:

4.8.1. Proximity to heating and cooling loads and the requirement to minimize energy transport factors and the size and complexity of the conveyance system (e.g. air ducts and heating piping).

4.8.2. Accessibility for installation, operation, maintenance, servicing, removal and replacement. See also Accessibility for Operation and Maintenance, below.

4.8.3. Provision for future increases in plant capacity and building expansion with minimal changes to the initial plant and to the structure.

4.8.4. Isolation of noise and vibration generating equipment from conference rooms, audio facilities and other sensitive areas.

4.8.5. Need for, and restrictions in, the location and height of a chimney.

4.8.6. Quality of outside air and location of outside air intakes.

4.8.7. Quality of air to be exhausted and location of exhaust air terminals.

4.8.8. Relative locations of associated mechanical equipment. For example: chillers to cooling towers.

4.8.9. Requirements of applicable codes, standards, and regulations.

4.8.10. Aesthetic considerations. For example, a penthouse equipment room may help to conceal an elevator penthouse.

4.8.11. If a mechanical penthouse is utilized, it shall be accessible by a permanent set of stairs and without crossing the roof of the building. Stairs for this purpose are defined as a maximum rise of 175 mm (7") with a minimum tread of 225 mm (9").

- 4.8.12. Necessity for safety to the building population.
- 4.8.13. Air handling units shall not be located over or beside learning spaces, conference rooms, sleeping quarters, broadcasting, or similar audio facilities. In addition, they shall not be located over administration areas, cafeterias or gymnasiums. Other spaces such as washrooms, storage rooms, etc. shall be used as sound and vibration buffers.
- 4.8.14. Boiler rooms shall be located on the lowest building level. Other arrangements may be considered but will be allowed only with written permission from DPW.

## 5. Ventilation Design Considerations

- 5.1. Fuel-fired equipment (e.g. boilers, generators) shall be kept in separate rooms from air handling equipment. For ventilation of rooms with fuel fired equipment, provide a fixed combustion air opening, along with separate openings using thermostatically controlled equally balanced supply and exhaust fans c/w motorized dampers, so that a space temperature of 35 °C (95 °F) at design summer conditions is not exceeded. The fans shall be interlocked so that one cannot run without proof the other is operating correctly.
- 5.2. Also provide thermostatically controlled ventilation in other mechanical rooms (e.g. air handling equipment rooms) so that a temperature of 35 °C (95 °F) at design summer conditions is not exceeded. Provide an exhaust fan along with an outside air louvre c/w motorized damper interlocked with the exhaust fan and its motorized damper.
- 5.3. Provide thermostatically controlled ventilation in transformer and electrical rooms to the latest Canadian Electrical Code, Nova Scotia Power Inc. (NSPI) and local electrical authority requirements. Coordinate with the electrical design engineer. Provide an exhaust fan along with an outside air louvre c/w motorized damper interlocked with the exhaust fan and its motorized damper.
- 5.4. Give consideration to heat and noise transmission from equipment to occupied spaces.
- 5.5. If a roof is the chosen location for air handling units, then the units shall be housed in penthouses with permanent stair access. Ancillary equipment (where appropriate) shall also be housed in penthouses with permanent stair access. See above for stair definition and access requirements.
- 5.6. Rooftop (exposed on the roof) air handling units and ancillary equipment will not normally be allowed and will be permitted only if specific written permission is obtained from DPW. If permission is obtained from DPW to use

rooftop machinery, then factors which are to be taken into account shall include, but not be limited to, the following:

- 5.6.1. Snow accumulation: the vertical distance between the finished roof surface and the bottom of the air intake louvre shall be at least 76cm (30 inches), and more when drifting of snow may be anticipated.
- 5.6.2. Integrity of the roof waterproof membrane; this will normally require the installation of sleepers to support the equipment; all penetrations of the waterproof roofing membrane shall be properly designed, flashed and sealed.
- 5.6.3. Safety of maintenance personnel; this requires walkways, railings and other safety features, as well as maintenance platforms.
- 5.6.4. Noise from the equipment causing disturbance and annoyance to occupants of nearby properties.
- 5.6.5. Exposure to ambient conditions; heat losses from, or heat gains to, the equipment may be greater than for similar equipment installed in a mechanical equipment room.
- 5.7. Kitchen facilities shall be ventilated with outside air. Kitchens with exhaust hood volumes 42 m<sup>3</sup>/min (1500 cfm) and above shall be ventilated directly with a dedicated 100% outside air unit sized to meet the exhaust volume.
- 5.8. Kitchens with exhaust hood volumes less than 42 m<sup>3</sup>/min (1500 cfm) may be ventilated with outside air from the air handling unit that serves the cafeteria with the air handling unit providing additional outside air to meet the exhaust hood volume via an interlock with the exhaust hood fan. Also provide an interlock to automatically bring on this air handling unit if the kitchen hood exhaust fan is turned on when the air handling unit is scheduled off.
- 5.9. Provide kitchen ventilation and use a dedicated general exhaust fan for removal of heat generated from equipment and to maintain air movement through the kitchen when the exhaust hood is off (the exhaust fan shall run continuously during occupied periods). Do not use the exhaust hood for general ventilation purposes. All return/exhaust air from the kitchen shall be ducted directly to the outside (not through an air handling unit).
- 5.10. Air handling units serving kitchen/cafeteria areas are not permitted to also serve spaces such as offices, classrooms, gymnasiums or administration areas. Arrangements where the air handling unit serves kitchen/cafeteria areas as well as other spaces may be considered but will be permitted only if specific written permission is obtained from DPW. To be considered, the unit shall provide 100% outside air (no return air) and, as noted above, all return/exhaust air from the kitchen shall be ducted directly to the outside, not through the air handling unit.

- 5.11. For spaces with wide variations in occupancy (e.g. gymnasium used periodically as an assembly or performance space) provide an automated method for varying the outside air volume. This is usually accomplished using return air carbon dioxide level control. Ensure the carbon dioxide sensor is installed in a location easily accessible to maintenance personnel (e.g. the mechanical room).
  - 5.12. Provide mechanical cooling (also utilize free cooling with outside air when conditions permit) when necessary to maintain health and comfort conditions in a space (e.g. rooms with computers may require cooling equipment to achieve an acceptable environment).
  - 5.13. Provide cooling by mechanical means only with no free cooling to protect temperature and humidity sensitive equipment such as server room computers or objects such as artworks in a controlled storage area. Communication Rooms and Server Rooms shall not be ventilated or cooled with air from an adjoining space (e.g. corridor).
  - 5.14. When equipment such as mechanical cooling condensers are installed on the roof, mount the equipment on pre-manufactured welded galvanized angle iron stands that give a minimum clearance of 46cm (18") between the finished roof surface and the underside of the equipment. The stands shall be mechanically fastened to the roof structure (e.g. Thaler anchors). Pressure treated blocking on the roof surface is not permitted.
6. Air Distribution Design Considerations
    - 6.1. General
      - 6.1.1. All supply, return and exhaust air systems shall be completely ducted from the air handling equipment to the ceiling supply diffusers and ceiling return/exhaust grilles.
      - 6.1.2. The location of air intake louvres shall be carefully considered relative to prevailing wind pressure and direction. Ensure that air intakes are not adversely affected by hot roof surfaces or by foul and hazardous exhaust discharge such as car, truck and bus exhausts, chimneys and building exhaust louvres. Also locate intakes to avoid drawing in combustible material and to minimize the hazard from fires in other structures.
      - 6.1.3. The air distribution system may be used for smoke control providing it meets with Fire Marshal approval.
      - 6.1.4. No stairwell, ramp, or other portion of the exit facilities of the building involved in the vertical portion of the exit pattern, or in a protected hallway leading from the discharge point of a vertical exit to the outside of the building, shall be used for the distribution of air.



## 6.2. Exhaust Systems

- 6.2.1. Spaces which house sources of odours and/or contaminants shall be ventilated mechanically by exhaust systems which are not part of other building ventilation systems.
- 6.2.2. Whenever a stack, duct shaft, or other enclosed ventilation means are used, adequate access shall be provided so that the entire system has proper access openings a maximum of 6m (20 feet) apart.
- 6.2.3. Any system used to prevent the hazardous accumulation of vapours, dust, fumes, grease, etc., shall not be interconnected or form part of any other ventilation, air conditioning, or exhaust system. (e.g. provide a dedicated exhaust fan and ductwork for a kitchen grease hood, run directly to the outside).
- 6.2.4. Exhaust fans shall be located near the point of air discharge to the outside, so that the exhaust ductwork is maintained at a negative pressure, thereby reducing the probability of contaminants infiltrating into the building.
- 6.2.5. Odourous/contaminated exhausts, for example, from washrooms, janitors' closets, boiler rooms and recycle rooms, shall discharge at the building roof and are not permitted to be sidewall exhausted. However, small individual washroom exhausts (excluding assistive care washrooms) may be sidewall exhausted, provided that the exhaust outlet is a minimum of 3m (10 feet) from any building opening (including windows, air intakes etc.)

## 7. Heating Design Considerations

### 7.1. General

- 7.1.1. Zone for most economical sizes and flow arrangements, and for effective thermostatic control of space temperatures.
- 7.1.2. Piping systems shall be designed using the two-pipe reverse return principle, unless written permission to do otherwise is obtained from DPW.
- 7.1.3. Systems shall be designed and installed to prevent thermal shock to the heating boilers. Piping layout and equipment shall be provided to ensure proper mixing and maintain a minimum water flow and temperature through the heating boilers, in no circumstances less than the boiler manufacturer's recommendations. See also Section 23 52 00 - Boilers and Division 25 - Integrated Automation.

- 7.2. Provide separate circulation loops (c/w three-way valve and pump) for:

- 7.2.1. Air handling unit coils
- 7.2.2. Unit, convection, wallfin, forceflow heaters and radiant ceiling panels
- 7.2.3. Radiant floor systems
- 7.2.4. Domestic hot water systems
- 7.3. Provide 100% standby pumping back-up on circulation loops to space heating units. Provide 100% standby pumps or utilize parallel pumping on the main pumps serving the air handling unit coils (both water and glycol sides).
- 7.4. Water Temperature and Flow Rates
  - 7.4.1. To determine system flow rate use diversity factor where applicable.
  - 7.4.2. For each terminal unit, select the smallest flow rate and highest temperature which will provide desired capacity and satisfy air purging requirements.
- 7.5. System Pressure Drops and Flow Balance
  - 7.5.1. Where coils have widely different design flow rates, select or specify internal coil circuiting to provide equal coil water pressure drops at design flow rates.
- 8. Accessibility for Operation and Maintenance
  - 8.1. General
    - 8.1.1. All mechanical equipment and components shall be located to be readily accessible for servicing and maintenance, and so as to be easily isolated, removed and replaced (e.g. infloor heating manifolds).
    - 8.1.2. Interference to building occupants: Maintenance and servicing of mechanical equipment and services shall be performed without undue interference with normal work performed by the building occupants.
  - 8.2. Accessibility
    - 8.2.1. Mechanical systems shall be designed, and mechanical rooms shall be laid out, and space requirements for maintenance and servicing (e.g. tube, coil or filter withdrawal space) shall be sufficient so as to permit all qualified manufacturers and suppliers to participate in competitive bidding. In addition, these factors shall permit the use of standard cleaning equipment and procedures. Design drawings shall indicate tube, coil and filter removal requirements.
    - 8.2.2. Space for tube bundle withdrawal and cleaning of tubes shall be provided. Layouts shall be arranged so no other piece(s) of

equipment need to be distributed nor systems shut down, when withdrawal or servicing is carried out.

### 8.3. Access Doors and Panels

- 8.3.1. Access doors or panels shall be installed wherever valves, water hammer arresters, plumbing cleanouts, trap primers, drain points, automatic and manual air vents, controllers, controlled devices, volume dampers, duct access doors and panels and where any equipment and system components requiring servicing, inspection or adjusting etc. are not accessible. Where equipment may be required to be removed for repair or servicing, adequate access must be provided.
- 8.3.2. Access to space above lay-in tile ceilings shall be by removal of lay-in tiles.
- 8.3.3. All openings shall be of sufficient size for both removal and maintenance of the concealed equipment and shall be a minimum size of 30cm x 30cm (12" x 12") for hand access and 61cm x 61 cm (24" x 24") for body access.
- 8.3.4. Doors shall open greater than 90 degrees, have concealed hangers, anchor straps, and Allen head cam locks (due to paint over).
- 8.3.5. Doors in block walls or in tile shall be sized to suit masonry unit module.
- 8.3.6. In fire rated walls and ceilings, access doors and panels shall be fire rated.
- 8.3.7. Provide stainless steel access doors for tile, marble or terrazzo surfaces.
- 8.3.8. Provide insulated access doors when installed in insulated ductwork.

### 8.4. Mechanical Equipment

- 8.4.1. Where possible, all piping connections, filter access, electrical wiring connections, motor and drive shall be on the same side of the equipment.
  - 8.4.1.1. Minimum clearance around each item of equipment for servicing, maintenance, removal and replacement shall be the greater of either 1219mm (48") or the size of the largest replacement component plus 508mm (20").
  - 8.4.1.2. There shall be a minimum of 457mm (18 inch) clearance between equipment and walls, regardless of whether

maintenance access openings are present on wall side of the equipment.

8.4.2. In addition, adequate space shall be provided all round each item of equipment for operation, maintenance and servicing, such as boiler and chiller tube cleaning, withdrawal and replacement, firetube boiler and door swing space, heating convertor and domestic hot water storage heater tube bundle withdrawal ERV door swing space.

8.4.3. Equipment maintenance drains (e.g. pump drains) shall be provided with cap and chain.

8.4.4. Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

#### 8.5. Ceiling Spaces

8.5.1. Ceiling space mounted equipment (e.g. exhaust fans, fan coils, heat pumps, motorized dampers) are to be within 91cm (36") of the finished ceiling so that they can be safely accessed.

#### 8.6. Piping Connections

8.6.1. Piping connections shall be arranged so that the component can be isolated (with isolation valve where required), removed and replaced simply by dismantling unions or flanges on the equipment in question, without disturbing, dismantling or shutting down any other services.

8.6.2. All control valves and tempering valves shall be installed with flanges or unions.

#### 8.7. Electrical Equipment

8.7.1. Minimum clearances around electrically fed equipment supplied by Divisions 21 - 28 (e.g. control panels) shall be the greater of that required by this Article (Accessibility For Operation and Maintenance) or that required by the latest edition of the Canadian Electrical Code.

#### 8.8. Space for Removal and Replacement

8.8.1. There shall be adequate aisle space and paths of egress, including corridors, vestibules, elevators, areaways, light wells, etc.

8.8.2. Elements of equipment shall be located so that they can be serviced or replaced without dismantling any other services or elements.

8.8.3. Avoid service and replacement access interference with removable partitions.

8.9. Equipment Connection

8.9.1. Provide piping with isolating shut-off valves, so that servicing of components does not interfere with the building services.

8.9.2. Provide unions or flanges to permit coil or terminal unit removal.

9. Commissioning of Facility Services

9.1. Related Sections:

9.1.1. Refer also to Section 01 70 00 - Contract Closeout for General Commissioning and FPTP requirements, Section 25 01 11 for testing and commissioning requirements for integrated automation (BAS) and Section 26 08 00 for Electrical Commissioning Requirements.

9.2. Mechanical System Functional Performance Testing Program<sup>9</sup>.

9.2.1. Upon receipt of written verification that all systems are complete, started-up and operational in all respects, all specified documents have been submitted and approved, and that all demonstrations have been completed and documented, DPW will commence a program of functional performance testing. This program is separate from the design engineer's and contractor's inspections and verifications. In no way shall the contractor, subcontractors or design engineer rely on the functional performance testing by DPW to determine the readiness of the mechanical systems.

9.2.2. During this program period, a department team will inspect equipment, operate systems and assess operation and performance as deemed necessary. The testing process may involve real or simulated conditions to determine the system's full operational capabilities and sequences. Copies of all specified mechanical and controls reports and documents are to be made available by the contractor in advance for use by the team during the testing program.

9.2.3. DPW will provide all typical HVAC test equipment and laptop computers required for their own use during the program. Where mechanical equipment is specified to interface with personal computers, the contractor shall provide the required connectors and any necessary interface software. The contractor shall ensure that subcontractors or equipment suppliers provide the specialized test equipment required for the functional testing program as per the individual mechanical specifications.

9.2.4. During the testing process, the on-site foreman of the mechanical sub-trade involved in the supervision of the work plus any equipment

suppliers' representatives as required, are to be available on site within forty-eight hours' notice and by telephone at other times to provide assistance to the team. Likewise, the mechanical design engineer shall be available via telephone for consultation on design related issues arising during the test program.

- 9.2.5. The contractor shall commence correcting deficiencies or discrepancies discovered during the functional performance testing process immediately after the test results are presented in writing. The contractor shall return copies of the deficiency lists to DPW via the design engineer with all corrected items signed off.
- 9.2.6. Although a majority of the functional performance testing will be conducted as quickly as possible when the building is ready, the program will not be considered complete until a variety of seasonal weather conditions are encountered during testing, and until all deficiencies are corrected.
- 9.2.7. Tests – General
  - 9.2.7.1. The following are supplementary conditions to tests specified in other sections of this document.
    - 9.2.7.1.1. Insulate and conceal work only after testing and approval by the mechanical design engineer. Conduct tests in presence of mechanical design engineer or person authorized by mechanical design engineer.
    - 9.2.7.1.2. Bear costs including retesting and making good. Replace defective material or equipment and repair joints using new material.
    - 9.2.7.1.3. Prior to tests, isolate all equipment or components which are not designed to withstand test pressures or test medium.
    - 9.2.7.1.4. Pipe Pressure
      - 9.2.7.1.4.1. General - maintain test pressure without loss for a minimum of two hours unless otherwise specified.
      - 9.2.7.1.4.2. Test fuel oil systems to CSA B139 (CSA B139 SERIES:19) and authorities having jurisdiction.
      - 9.2.7.1.4.3. Test drainage, waste and vent piping to the latest National Plumbing Code of

Canada and authorities having jurisdiction. Ensure a minimum 3m (10') head of water is provided above the highest point of the DWV system. DWV piping shall be tested for a minimum of one hour with water, or two hours with air. In addition, a video inspection of the underground piping shall be conducted in the presence of the mechanical design engineer and DPW mechanical inspector, after piping has been backfilled, and provide a copy of the video inspection. Provide a minimum of four working days' notice of the time for this test.

- 9.2.7.1.4.4. Test domestic hot, cold and recirculation water piping at 1-1/2 times the system operating pressure or minimum 862kPa (125 psi), whichever is greater.
- 9.2.7.1.4.5. Test all hydronic systems at 1-1/2 times the system operating pressure or minimum 862kPa (125 psi), whichever is greater.
- 9.2.7.1.4.6. Fire systems in Division 21 shall be tested in accordance with authorities having jurisdiction and as noted in Division 21.
- 9.2.7.1.4.7. Test propane and/or natural gas systems to CSA B149 and authorities having jurisdiction.
- 9.2.7.1.5. Test backflow preventers in accordance with local water utility or municipality.
- 9.2.7.1.6. Test domestic water quality as specified in Division 01 and Division 21 & 22.
- 9.2.7.1.7. Test boilers as specified in Section 23 52 00.
- 9.2.7.1.8. Test chemical treatment and anti-freeze solutions and provide written reports indicating required parameters have been obtained.
- 9.2.8. All tests and inspections are to have a minimum of four working days' notice. If a test is cancelled, a minimum of four additional working days' notice is required.

- 9.3. Commissioning of Plumbing
  - 9.3.1. Cleaning and Disinfection
    - 9.3.1.1. After system pressure testing is complete, flush and disinfect domestic water system to requirements of authorities having jurisdiction.
  - 9.3.2. Maintain manual and automatic valves in full open position during cleaning process.
  - 9.3.3. Upon completion, contractor to provide laboratory test results on the domestic water quality (tests as per authorities having jurisdiction) to mechanical design engineer. Tests shall be as per the requirements of the Nova Scotia Department of Labour, Skills, and Immigration. Mechanical design engineer shall review the test results and forward recommendations to DPW on the acceptability of the domestic water system.
- 9.4. Mechanical (HVAC) - Testing, Adjusting and Balancing
  - 9.4.1. Air Distribution Systems
    - 9.4.1.1. Test and balance all air supply, return, and exhaust systems. Balancing must be performed by trained personnel who shall keep records on each trial balance.
    - 9.4.1.2. Balancing shall be accomplished by means of pitot tube traverse on all main and branch ducts. Fan speeds and dampers shall be adjusted until proper air quantities are obtained.
    - 9.4.1.3. Each outlet shall be adjusted by anemometer, voltmeter readings to provide specified air quantities. Each supply outlet shall be adjusted to provide proper throw and distribution in accordance with requirements.
    - 9.4.1.4. All necessary equipment including gauges, pitot tubes, anemometers, voltmeters, etc. required for the testing and air balance shall be furnished and of quality and capacity to ensure proper accuracy.
    - 9.4.1.5. Upon completion of the balancing, supply three (3) complete records which shall include air quantities at each outlet. Provide, if requested, a spot check on each system. If actual quantities do not agree with the balance report, this contractor may be called upon to completely re-balance the systems until satisfactory to the Engineer.



- 9.4.1.6. Adjust air flow at registers and grilles to equalize volume supplied and withdrawn from each room or as indicated on the plans. Balancing to be performed using duct balancing dampers, grille dampers to be used for fine tuning only.
- 9.4.1.7. Provide the following information as part of the balancing report:
  - 9.4.1.7.1. System No.
  - 9.4.1.7.2. System Location
  - 9.4.1.7.3. Area System Serves
  - 9.4.1.7.4. Specified CFM
  - 9.4.1.7.5. Actual CFM
  - 9.4.1.7.6. Specified Suction S.P.
  - 9.4.1.7.7. Actual Suction S.P.
  - 9.4.1.7.8. Specified Discharge S.P.
  - 9.4.1.7.9. Actual Discharge S.P.
  - 9.4.1.7.10. Specified Total S.P.
  - 9.4.1.7.11. Actual Total S.P.
  - 9.4.1.7.12. Type of Sheave and Location (Motor or Fan)
  - 9.4.1.7.13. Position of Sheave (i.e. Maximum or Minimum RPM)
  - 9.4.1.7.14. Motor HP
  - 9.4.1.7.15. Fan Rated HP
  - 9.4.1.7.16. Amp Draw on each Phase
  - 9.4.1.7.17. Measured voltage
  - 9.4.1.7.18. Motor RPM
  - 9.4.1.7.19. Fan RPM Specified
  - 9.4.1.7.20. Fan RPM Actual
  - 9.4.1.7.21. Individual diffuser reports shall include:
    - 9.4.1.7.22. Diffuser type
    - 9.4.1.7.23. Velocity ft/min
    - 9.4.1.7.24. Diffuser Multiplier
    - 9.4.1.7.25. Specified CFM

9.4.1.7.26. Actual CFM

9.4.1.8. Provide fan curves for each fan showing plotted design and field conditions, static pressure readings across filter banks, coil banks of each air handling system, showing design and actual readings.

9.4.1.9. Provide a detailed summary of velocity traverses and calculated air quantities for each fan and branch ductwork. Provide schematic diagrams for all systems with all outlets numbered. All openings shall be closed using removable gasketed plugs. All balancing shall be done to AABC Standards.

9.4.2. Water Circulating Systems

9.4.2.1. Balance water flow through all equipment including heating coils, cooling coils, chillers, etc. Upon completion of the balancing, and supply three (3) copies of the balancing reports. Contractor may be called upon to completely re-balance the systems. Record design and actual temperatures, pressures and flow rates.

9.4.2.2. Use the metering stations to obtain water flows in main piping systems. Provide pump curves for each pump showing plotted design conditions and field conditions and water on and off temperatures at each major piece of equipment. Provide schematics for all systems with all metering points numbered.

9.4.3. Mechanical Designer's Verification

9.4.3.1. Mechanical design engineer shall verify in writing a minimum of 30% of each type of measurement provided in the balancing reports.

**END**

## DIVISION 21 - FIRE SUPPRESSION

### Section 21 00 00 Fire Suppression - General

#### 1. Codes, Standards and Approvals

- 1.1. The design and installation shall comply with the latest requirements of NFPA and the NFC.
- 1.2. Water supplies to fire protection equipment or systems require the approval of the Provincial Fire Marshall.
- 1.3. Hydraulic design calculations with drawings shall be submitted to the Provincial Fire Marshall. Construction of the fire protection system shall not commence until these calculations and drawings are approved by same.
- 1.4. Where a manufacturer or product name is given, DPW will also consider other "equal" products if requested in writing. Written approval by DPW is required before the product will be permitted on the project.
- 1.5. Refer also to Divisions 22 and 28 for additional requirements. For example, fire pump installations have accessibility, vibration isolation, identification, insulation, ventilation and other requirements which are outlined in the various subsections of Facility Services Subgroup Divisions. Pipe hanger and support requirements shall be as per related Facility Services Subgroup - General (FSS-G) requirements.
- 1.6. Varying, or deviating from any item(s) indicated in this document must be approved by DPW. DPW will not grant a deviation from these requirements unless the deviation has been submitted in writing for review and approved, in accordance with the requirements stated in the Preface of the DC350, prior to proceeding with the design.

#### 2. Fire Protection

##### 2.1. General

- 2.1.1. The materials, equipment and assemblies shall meet the minimum requirements of Underwriters Laboratories of Canada.
- 2.1.2. No water main supplying a hydrant system is to be less than NPS 6 diameter. Dead- ended mains are to be avoided where possible by looping of mains. Sectional valves are to be installed so that the majority of hydrants may remain in service during a water outage caused by a break or maintenance.

3. Fire Protection Water Supply Sources

3.1. There may be areas where there is no established water supply, but due to features of construction and occupancy, a water supply for a system of fire hydrants, sprinklers, etc. is required. Water supply sources may consist of a connection to a public or private water main system, gravity tank, compartmentalized reservoir and fire pumps, rivers, lakes, etc.

3.2. In areas where there is no established water supply and an outside hydrant system is not required, a water supply for an internal fire hose and standpipe system may be required. Water supply sources may consist of a pressure tank or a non-pressurized source, such as a reservoir, cistern or tank with a pumping system.

4. Where water storage is required, fire protection water shall be held in a separate storage device which may be located in or under rooms containing mechanical equipment and/or fuel storage tanks (this is not permitted for other underground cisterns/reservoirs). Potable water shall be stored above grade but is not permitted in boiler rooms or other spaces with heat generating equipment. The minimum storage volume for water serving the plumbing fixtures shall be two days supply, based on a minimum usage of 12 litres/day per occupant for potable water and 12 litres/day per occupant for non-potable (e.g. toilet flushing) water.

4.1. Mechanical design engineer to consult with DPW on project requirements for non-potable water supply and rainwater collection systems

5. Protection of Completed Work

5.1. Protect exposed pipe, fittings and equipment from damage prior to final project completion. Provide cULus listed and approved wire guards for sprinkler in mechanical and electrical rooms, storage rooms and where sprinklers are subject to damage

6. Commissioning shall be as per related Facility Services Subgroup- General (FSS-G) requirements.

## Section 21 05 00 Common Work Results for Fire Suppression

### 1. Piping

- 1.1. Steel pipe schedule 10 (rolled grooved) or schedule 40 (screwed, rolled grooved ) for sizes up to 51mm (2")
- 1.2. Schedule 10 roll grooved or schedule 40 (welded, rolled grooved or flanged) for pipe 64mm (2½") and up.
- 1.3. Where rolled grooved products are used, they shall be of the same manufacturer.
- 1.4. Lightwall pipe up to 51mm (2")
- 1.5. Flexible stainless-steel sprinkler drop system in lieu of rigid pipe and return bends for sprinkler drops shall be permitted in finished ceilings. The flexible sprinkler drop system shall be cULus listed 25mm (1") ID with the maximum number of allowable bends at the listed minimum bend radius of 51mm (2") attached to the ceiling using a one-piece bracket.

### 2. Roll Grooved Joints

#### 2.1. General

##### 2.1.1. References

###### 2.1.1.1. American Water Works Association (AWWA)

###### 2.1.1.1.1. AWWA C111/A21.11-17, Rubber Gasket Joints for Ductile-Iron and Fittings.

###### 2.1.1.2. CSA B242-05 (R2016), Groove and Shoulder Type Mechanical Pipe Couplings.

##### 2.1.2. Maintenance

###### 2.1.2.1. Extra materials

###### 2.1.2.1.1. Provide the following spare parts:

###### 2.1.2.1.1.1. Gaskets for flanges: one for every ten flanges.

#### 2.2. Products

##### 2.2.1. Pipe Joints

###### 2.2.1.1. Roll grooved: to CSA B242-05 (R2016) latest edition, Groove and Shoulder Type Mechanical Pipe Couplings.

2.2.1.2. Roll grooved: Joints to be rigid, except at expansion loops, elbows and pumps where flexible couplings shall be used.

2.2.1.3. Roll grooved products shall be of one manufacturer and have CRNS for Nova Scotia.

#### 2.2.2. Fittings

2.2.2.1. Fittings for roll grooved piping malleable iron to ASTM A47/A47M-99(2018)e1 on ductile iron to ASTM A536-84(2019)e1.

#### 2.2.3. Gaskets

2.2.3.1. Roll grooved couplings gaskets: type EPDM

2.2.3.2. Gaskets shall be good for ambient temperatures as required by cULus.

2.2.3.3. Gaskets for other services require approval in writing from DPW.

2.2.3.4. In lieu of rigid pipe or arm over return bends for sprinkler drops, a flexible stainless-steel sprinkler drop system may be used to locate sprinklers in a finished ceiling. The flexible sprinkler drop system shall be cULus listed 25mm (1") ID at the maximum number of allowable bends at the listed minimum bend radius of 51mm (2") and attached to the ceiling using a one-piece bracket.

#### 2.2.4. Valves

##### 2.2.4.1. Connections

2.2.4.1.1. DN 50 (NPS 2) and larger:

2.2.4.1.1.1. Grooved ends: as specified.

##### 2.2.4.2. Butterfly valves: Application: Isolating equipment:

2.2.4.2.1. DN 65 (NPS 2 ½) and larger:

2.2.4.2.1.1. Grooved ends: as specified.

##### 2.2.4.3. Swing check Valves: to MSS-SP-71 (MSS SP-71-2018).

2.2.4.3.1. DN 65 (NPS 2 ½) and larger:

2.2.4.3.1.1. Grooved ends: as specified.

##### 2.2.4.4. Silent check valves:

2.2.4.4.1. DN 65 (NPS 2 ½) and larger:

2.2.4.4.1.1. Grooved ends: as specified.

3. Fittings

- 3.1. For steel pipe 1034kPa (150 PSI) malleable banded iron screwed or 1034kPa (150 PSI) cast iron flanged.
- 3.2. Rigid lightweight / standard angle pattern shall conform to ASTM A536 (ASTM A536-84(2019)e1 W/E gasket.
- 3.3. Bolts shall be square or hex head.
- 3.4. Flange Gaskets shall be 1.6mm (1/16") thick cloth inserted red rubber.

4. Valves

- 4.1. Valves up to DN 40 (NPS 1 ½") shall be supervised bronze, screwed ends, O.S.&Y gate or ball valve. Valves DN 50 (NPS 2) and over shall be cast iron flanged or grooved gate valves.

5. Pressure Gauges

- 5.1. 114mm (4½") diameter, cast aluminum, close type black finished ring and clear glass window. Dial to have white finish with jet black embossed figures and graduations. Permanent legibility shall be ensured by a hot dip stamp process. The pointer shall be adjustable black finish, with red tip. Movement shall be bronze with bronze bushing. The bourdon tube shall be Phosphor bronze soldered to socket and tip. Accuracy to be 1% over middle half of scale range and 1½% over balance. All gauges to be c/w snubbers and mini ball valves.

6. Alarm Valves

- 6.1. Furnish and install regulatory approved automatic alarm valves c/w accessories including excess pressure pump. Provide all necessary trim and connections from alarm valve including valves, drips, drainpipes, gauges, water motor gong and pressure and supervisory switches.

7. Finishes

- 7.1. Provide chrome plated sprinklers, valves, nozzles, fittings etc., except in unfinished areas where brass finish is acceptable. Underwriters Laboratories labeled.

8. Backflow Preventer

- 8.1. Refer also to 22 11 19 for backflow preventer requirements related to plumbing.
- 8.2. A separate building water entry shall be provided for the fire protection system. On the main fire protection system water supply, provide backflow protection to the Municipality requirements with minimum requirement being a double check backflow preventer.

9. Flow and Supervisory Stations for Instrumentation and Control of Fire-Suppression Systems
  - 9.1. Provide supervised shut-off valves and electric supervisory flow switches for bottom and top of hydraulic elevators, kitchen hoods, and any areas requiring zoning.



## Section 21 05 29 Hangers and Supports for Fire Suppression Piping and Equipment

### 1. Bases, Hangers and Supports

#### 1.1. Foundations and Bases

- 1.1.1. All mechanical equipment shall be mounted on 102mm (4 inch high) (minimum) concrete foundations, curbs, or housekeeping pads. In lieu of these concrete bases, steel or cast-iron cradles, saddles or stands may be considered for some equipment but will be allowed only with written permission from DPW.
- 1.1.2. Concrete bases shall be a minimum of 102mm (4") larger all around than the equipment and have chamfered edges. Ensure bases are level prior to placement of equipment.

#### 1.2. Pipe Hangers and Supports

- 1.2.1. Provide all hangers required for the proper support of piping. Hangers shall be steel adjustable clevis type, epoxy coated or copper plated where in contact with copper piping.
- 1.2.2. Provide cadmium plated threaded steel rods with nuts and washers. All hanger rod installations to be double nutted (top and bottom).
- 1.2.3. Hangers to be within 30cm (12") of at least one end of each elbow. Roller hangers to be provided where expansion dictates.
- 1.2.4. In concrete construction, use self drilling inserts at proper centers securely anchored in concrete.
- 1.2.5. Beam clamps shall be used when hanging from any structural steel members. No drilling or welding of these members shall be permitted.
- 1.2.6. Supporting bolts shall be maximum sizes usable with the specified hanger, with adjustable and locking stop units.
- 1.2.7. All piping to be hung so that if coils, 3 way valves or pumps were disconnected or removed, pipe would remain in place without sagging or requiring additional hanging.
- 1.2.8. Vertical pipes shall be supported at each floor by means of iron hooks or clamp hangers placed directly below hub or fittings.
- 1.2.9. Install piping on spring hangers where vertical movement of the pipe is 12.7mm (½") or more, or the transfer of load to adjacent hangers or connected equipment is not permitted.

- 1.2.10. When roll grooved piping is used, any piece 122cm (48") or longer shall have a minimum of one support.
- 1.2.11. Spacing shall be as per the most stringent of the following requirements, code requirements and authorities having jurisdiction.

Nominal Pipe Size	Hanger Rod Diameter	Maximum Spacing: Steel	Maximum Spacing: Copper
Up to 1¼" (32mm)	3/8" (10mm)	7'-0" (2100mm)	6'-0" (1800mm)
1½" (40mm)	3/8" (10mm)	9'-0" (2700mm)	8'-0" (2400mm)
2" (50mm)	3/8" (10mm)	10'-0" (3000mm)	9'-0" (2700mm)
2½" (65mm)	3/8" (10mm)	12'-0" (3700mm)	10'-0" (3000mm)
3" (80mm)	½" (12mm)	12'-0" (3700mm)	10'-0" (3000mm)
3½" (90mm)	½" (12mm)	13'-0" (4000mm)	11'-0" (3300mm)
4" (100mm)	½" (12mm)	14'-0" (4300mm)	12'-0" (3700mm)
6" (150mm)	¾" (20mm)	15'-0" (4600mm)	15'-0" (4600mm)
8" (200mm)	7/8" (22mm)	15'-0" (4600mm)	15'-0" (4600mm)
10" (250mm)	7/8" (22mm)	22'-0" (6700mm)	
12" (300mm)	7/8" (22mm)	23'-0" (7000mm)	

**Section 21 05 48 Vibration and Seismic Controls for Fire Suppression Piping and Equipment**

1. Refer also to 13 48 00 Sound Vibration and Seismic Control for general isolation requirements.
2. Install piping on spring hangers, inertia bases, RSR pads, etc. as required to maintain low sound and vibration levels.
3. Where lateral support of pipe risers is required, it shall be accomplished by use of resilient lateral supports.
4. Pipes that penetrate the building construction shall be isolated from the building structure by use of unit resilient penetrating sleeve/seals.
5. Parallel running pipes may be hung together on a trapeze which is isolated from the building. Do not mix isolated and non-isolated pipes on the same trapeze.

## Section 21 05 53 Identification for Fire Suppression Piping and Equipment

### 1. Manufacturers Nameplates

- 1.1. Each piece of equipment shall have a metal nameplate mechanically fastened to equipment, with raised or recessed letters. Nameplates to be located so that they are easily read. Do not insulate or paint over plates.
- 1.2. Include registration plates (e.g. pressure vessel, Underwriters' Laboratories and CSA approval) as required by respective agency and as specified. The supplier shall indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

### 2. System Nameplates

- 2.1. Major equipment to be identified with laminated plastic plates with black face and white center (lettering) of minimum size 89mm x 38mm x 2.4mm (3½" x 1½" x 3/32") nominal thickness, engraved with 12.7mm (½") high lettering.
- 2.2. Nameplates to be fastened securely with pop rivets or screws in conspicuous place. Where nameplates cannot be mounted, such as on cool surfaces, provide standoffs.
- 2.3. Unique mechanical identification tag shall follow naming system laid out on drawings and in specifications. Equipment type, number and service or areas or zone of building it serves to be identified.

### 3. Pipe Identification

- 3.1. Medium in piping to be identified as indicated below showing name and service, including temperature and pressure as indicated below, and directional flow arrows where relevant.
  - 3.1.1. Material shall be vinyl/plastic coated cloth with protective over coating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of 149 deg. C (300 deg. F) and intermittent temperature of 204 deg. C (400 deg. F).
  - 3.1.2. Tape shall be 51mm (2") wide single wrap around pipe or pipe covering with ends overlapping not less than 1". Tape is to be cut, not torn.
  - 3.1.3. Block capital letters 51mm (2") high for pipes of 76mm (3") nominal and larger o.d. including insulation and not less than 19mm (¾") high for smaller diameters shall be used.
  - 3.1.4. Direction arrows 152mm (6") long by 51mm (2") wide for piping of 76mm (3") nominal or large o.d. including insulation and 102mm (4")

long by 19mm ( $\frac{3}{4}$ " ) wide for smaller diameters to be used. Double headed arrows to be used where direction of flow is reversible.

- 3.1.5. Use black pipe marker letters and direction arrows. Use white on red background for fire protection pipe markers.
  - 3.1.6. Stenciled identification if used shall be from a first quality low VOCpaint, with letters a minimum of 51mm (2"). Use stenciling on all purpose or canvas insulation jackets only.
  - 3.1.7. A high-quality pre-manufactured identification system may be used in lieu of the identification noted above. Submit proposed product(s) to DPW and do not proceed until written approval received.
- 3.2. Location of Identification
- 3.2.1. Markers and classifying colours on piping systems to be located so they can be seen from floor or platform.
  - 3.2.2. Piping runs to be identified at least once in each room, regardless of whether concealed or in open areas.
  - 3.2.3. Do not exceed 15m (50'-0") between identification, regardless of whether concealed or in open areas.
  - 3.2.4. In addition, where piping is concealed in pipe chase or other confined space, point of entry and leaving, and each access opening to be identified.
  - 3.2.5. Both sides where piping passes through walls, partitions and floors to be identified.
  - 3.2.6. Piping to be identified at starting and ending points of runs and at each piece of equipment.
  - 3.2.7. Identify branch, equipment or building served after each valve. (ie. heating zones are to be identified in boiler rooms)
  - 3.2.8. Provide primary and secondary colour banding.
  - 3.2.9. Identification and colour coding shall be as per the following:

Pipe Marker	Valve Tag	Primary Colour	Second Colour
Fire Protection Water	F.P.W .	Red	White
Sprinkler Water	S.W	Red	White

#### 4. Valves

- 4.1. 38mm (1½") laminated plastic plates (tags) with corner hole shall be provided for all valves and installed with nonferrous chains, "S" hooks or heavy-duty plastic tie wraps. Tags shall have horizontal 12.7mm (½") letters accurately aligned and machine engraved into the core. Required for all valves and operating controllers.
  - 4.1.1. Provide one valve chart for each Operations and Maintenance manual and one chart framed and wall mounted.
  - 4.1.2. Valves in systems to be numbered consecutively.

## **Section 21 12 00 Fire Suppression Standpipes**

### **1. Standpipe and Hose Systems**

- 1.1. Where they are required, standpipe systems shall be installed in accordance with the NFPA (Fire) 14: 2019 Latest edition.

## Section 21 13 00 Fire Suppression Sprinkler Systems

### 1. Wet/Dry Pipe Sprinkler Systems

- 1.1. Pipe sizing and layout shall be by hydraulic design. Piping shall be ferrous. Where freeze protection is required, glycol antifreeze loops shall be avoided. If antifreeze loops must be used, antifreeze must be pre-mixed and cULus listed, provide reduced pressure type backflow prevention on the loop only.
- 1.2. Sprinklers shall be listed with and bear certification marking of nationally recognized testing agency.
- 1.3. Provide spare sprinkler cabinet with minimum of 6 sprinklers per type installed.
- 1.4. Provide minimum 12.7mm (½") nominal diameter discharge orifice.
- 1.5. With suspended ceiling tile systems, locate sprinklers in the center of ceiling tiles (where code, coverage etc. permits).
- 1.6. All sprinklers in storage rooms mechanical rooms, gymnasium, electrical rooms and underside of stage areas shall be c/w cULus listed guards.
- 1.7. All piping shall run concealed in finished areas. All main lines shall be kept as high and as neat as possible.
- 1.8. Install shut-off and check valves as required to complete the system and as required by the code.
- 1.9. Exposed piping passing through walls shall be supplied with wall plates on both sides.
- 1.10. Exposed piping passing through floors and ceilings shall be supplied with floor and ceiling plates.
- 1.11. Co-ordinate locations of all holes required for pipes and otherwise meet specified requirements of this document for installation of sleeves and pipe.
- 1.12. Install return bends on all sprinklers where the supply is from a well water system. Consult with DPW on the need for return bends when the supply is from other sources
- 1.13. The drop at sprinklers located within 61cm (24 inches) of surface mounted light fixtures or other obstructions shall be long enough to accommodate extended (deep) escutcheons.
- 1.14. Install horizontal valves with handles placed vertically on top, where space allows.



- 1.15. Arrange drains as indicated or as required so that all parts of the system can be drained.
  - 1.16. Pipe all drip drains from pre-action valve, supervisory valve locations and alarm valves to nearest plumbing drain. Do not hard pipe to the plumbing drain, provide atmospheric break.
  - 1.17. Where roll grooved products are used in dry systems, provide flush seal gaskets.
  - 1.18. Allow 15 extra sprinkler heads and associated piping to cover under large ducts, bulkheads, closets, etc. where unexpected heads may be required.
2. Ventilation Hoods
    - 2.1. Kitchen Hood Extinguishing System
      - 2.1.1. The kitchen cooking exhaust hood shall be protected by a wet chemical extinguishing system in accordance with the NFPA (Fire) 96: 2017 latest edition.

### Section 21 30 00 Fire Pumps

1. The need for fire pumps and fire water reservoirs is pending the availability and quality of municipal services.
2. Fire pumps, if required, shall be designed and installed in accordance with the requirements of NFPA Standard No. 20, the National Fire Code of Canada 2015 and authorities having jurisdiction and are to bear the approval label of ULC.
3. Fuel Storage tank for fuel fired fire pumps shall be double wall construction. Single wall fire pump day tanks located indoors shall be complete with a liquid tight 100% volume containment device around and under the tank. This device is to be separate from and independent of the tank.
4. If the fill and vent of the fuel storage tank are at a height where they cannot be reached by a person standing on the ground below, provide a fill service platform complete with stairs (ships ladder not acceptable). Platform/stairs to be 100% galvanized including railings and be complete with non-slip treads.
5. Fill pipe to fire pump fuel storage tank shall be complete with a 25 litre lockable spill container. As described in Section 23 10 00 provide an overflow preventer valve on the fill pipe, and a screened elbow and Vent-A-Larm on the vent pipe.
6. Fuel lines, fill and vent lines shall be Schedule 40 black steel, with socket weld fittings or Type L hard copper with silfos joints, with written permission by DPW only. Pipes located outdoors shall be primed and painted with corrosion resistant coatings.
7. Fire pump test loops shall use cULus supervised-closed valves only, reverse wired supervised-open valves are not acceptable.

**END**

## DIVISION 22 - PLUMBING

### Section 22 00 00 Plumbing - General

1. Codes, Standards and Approvals
  - 1.1. The more stringent requirements of the latest National Plumbing Code of Canada and these requirements shall be used for the design.
  - 1.2. Connection to municipal water supply shall have municipal approval.
  - 1.3. Varying, or deviating from any item(s) indicated in this document must be approved by DPW. DPW will not grant a deviation from these requirements unless the deviation has been submitted in writing for review and approved prior to proceeding with the design.
2. Water Supplies
  - 2.1. Every building shall be provided with a reliable and adequate water supply available to fire department mobile pumping apparatus, building fire protection systems and potable domestic water.
  - 2.2. Water Supply Systems:
    - 2.2.1. The minimum water pressure required for plumbing fixtures on the top floor of a building is 172kPa (25 psi)
    - 2.2.2. Conform to Nova Scotia Department of Environment and Labour standards for Canadian Drinking Water.
  - 2.3. Refer also to PART 2 Section 2, 21 00 00 for Fire Suppression additional requirements.
3. Plumbing
  - 3.1. Service Water Pipe
    - 3.1.1. Cement mortar lining for ductile iron pipe: to AWWA C104/A21.4-16.
  - 3.2. Sewage Pumps
    - 3.2.1. General: Only the facilities which cannot drain by gravity to the main sewer, shall be connected to the sump pit.
    - 3.2.2. Equipment for Raising Sewage: Use duplex sewage pumps with automatic transfer switch.
    - 3.2.3. Provide high water alarms in each sump pit.

3.3. Water Supply System

- 3.3.1. Service lines must enter the building in an accessible location. They must never enter in fuel rooms, storage rooms, switchgear rooms, or transformer vaults.

3.4. Domestic Hot Water

- 3.4.1. Generation of domestic hot water shall be by (a) standalone electric or hybrid heat-pump hot water heater(s). Alternative strategies for heating of domestic hot water may be considered but will be allowed only with written permission from DPW.

4. General Design Considerations

4.1. Provide isolating valves for:

- 4.1.1. For each piece of equipment.
- 4.1.2. For each group of fixtures or each bathroom and for each riser.
- 4.1.3. Whenever required by local plumbing code.
- 4.1.4. For sections of large buildings.
- 4.1.5. For all branches of water mains.

4.2. Commissioning shall be as per related Facility Services Subgroup- General (FSS-G) requirements

## Section 22 05 00 Common Work Results for Plumbing

### 1. Roll Grooved Joints

1.1 The more stringent requirements of the 2010 National Plumbing Code of Canada (2015) and these requirements shall be used for the design.

#### 1.1.1 References

1.1.1.1 American Water Works Association (AWWA)

1.1.1.1.1 ANSI/AWWA C111/A21.11-(00) (AWWA C111/A21.11-17), Rubber Gasket Joints for Ductile-Iron and Fittings.

1.1.1.2 CSA B242-M1980(R1998) (CSA B242-05 (R2016)), Groove and Shoulder Type Mechanical Pipe Couplings.

#### 1.1.2 Maintenance

1.1.2.1 Extra materials

1.1.2.1.1 Provide the following spare parts:

1.1.2.1.1.1 Gaskets for flanges: one for every ten flanges.

### 1.2 Products

#### 1.2.1 Pipe Joints

1.2.1.1 Roll grooved: to CSA B242 (CSA B242-05 (R2016)).

1.2.1.2 Roll grooved: Joints to be rigid, except at expansion loops, elbows and pumps where flexible couplings shall be used.

1.2.1.3 Roll grooved products shall be of one manufacturer and have CRNS for Nova Scotia.

#### 1.2.2 Fittings

1.2.2.1 Fittings for roll grooved piping malleable iron to ASTM A47/A47M-99(2018)e1 on ductile iron to ASTM A536-84(2019)e1.

#### 1.2.3 Gaskets

1.2.3.1 Roll grooved couplings gaskets: type EPDM

1.2.3.2 Gaskets shall be good for cold and hot water up to minimum 110deg C (230deg F)

1.2.3.3 Gaskets for other services require approval in writing from DPW

1.2.4 Valves

1.2.4.1 Connections

1.2.4.1.1 DN 65 (NPS 2 ½) and larger:

1.2.4.1.2 Grooved ends: as specified.

1.2.4.2 Butterfly valves: Application: Isolating equipment:

1.2.4.2.1 DN 65 (NPS 2 ½) and larger:

1.2.4.2.2 Grooved ends: as specified.

1.2.4.3 Swing check Valves: to MSS-SP-71 (MSS SP-71-2018).

1.2.4.3.1 DN 65 (NPS 2 ½) and larger:

1.2.4.3.2 Grooved ends: as specified.

1.2.4.4 Silent check valves.

1.2.4.4.1 DN 65 (NPS 2 ½) and larger:

1.2.4.4.2 Grooved ends: as specified.

2. Pressure/Temperature Relief Valve

2.1 Bronze body, maximum temperature of 93 deg. C (200°F) at 57kg (125 lbs). working pressure. A relief valve or expansion tank is required on domestic hot water systems. If a relief valve is used in lieu of an expansion tank, it shall be rated for no less than 80 psi and be designed for continuous use.

3. Pressure Reducing Cold Water Make-Up Assembly

3.1 Provide, if required, pressure reducing valve (complete with integral strainer and gate valve) on both inlet and outlet connections. Provide two pressure gauges, graduated to a gauge pressure of 862kPa (125 psi), to show inlet and outlet pressure of pressure reducing valve assembly. Provide pressure relief valve on reduced pressure side.

4. Pressure Reducing Valve

4.1 A pressure-reducing valve or valves, relief valve and strainer shall be installed on the domestic water mains wherever a pressure in excess of 552kPa (80 psi) may be expected. A globe valve bypass, the same size as reducing valve shall be provided. Include in the specifications the initial and final pressure and the required flow.

4.2 All valves shall be lead free.

## Section 22 05 19 Meters and Gauges for Plumbing Piping

1. Thermometers and Pressure Gauges
  - 1.1 Thermometers
    - 1.1.1 Adjustable type 23cm (9") graduated scale, metal casing, calibrated in degrees F and degrees C range to suit the normal operating temperature of the fluid.
    - 1.1.2 Locate and install thermometers to facilitate reading.
    - 1.1.3 For plumbing systems, install thermometers on the outlet of all DHW tanks and on the inlet and outlet of tempering valves. Also install thermometers on domestic hot water return (recirculation) piping.
  - 1.2 Pressure Gauges
    - 1.2.1 Gauges shall be 114mm (4½") diameter, cast aluminum, close type black finished ring and clear glass window, calibrated in both imperial and metric. Dials shall have white finish with jet black embossed figures and graduations.
    - 1.2.2 Permanent legibility shall be ensured by a hot dip stamp process. The pointer shall be adjustable, black finish with red tip.
    - 1.2.3 Movement shall be bronze with bronze bushing. The bourdon tube shall be phosphor bronze soldered to the socket and tip.
    - 1.2.4 Accuracy to be 1% over middle half of scale range and 1½% over balance. All gauges to be complete with snubbers and mini ball valves. Gauges on steam systems shall be complete with mini ball valves and pipe siphon.
    - 1.2.5 Locate and install pressure gauges to facilitate reading.
    - 1.2.6 For plumbing systems, provide calibrated pressure gauges for each pump over 373W (½ hp) (not required on DHW re-circulation pumps), on the water service inside the building, and on the outlets of pressure reducing valve assemblies.
2. Meters
  - 2.1 Provide each service connection with a meter, including where the source is other than municipal (e.g. provide meter where well used). Connections shall be provided in accordance with local requirements. Provide a pressure gauge downstream of the meter.
  - 2.2 Meters to be displacement type with pulse output and connected to building automation (controls) system. See Division 25 for additional requirements.

- 2.3 For all meters provide a strainer upstream. Also provide a valved bypass around the meter and a valve and union on both the inlet and outlet connections. If more than one meter is installed, place a check valve between the meter and shutoff valve on the building side of each meter. A drain valve piped to a floor drain is required on the building side of the meter just beyond the shutoff valve.



## Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment

### 1. Foundations and Bases

- 1.1. All mechanical equipment shall be mounted on 102mm (4 inch high) (minimum) concrete foundations, curbs, or housekeeping pads. In lieu of these concrete bases, steel or cast-iron cradles, saddles or stands may be considered for some equipment but will be allowed only with written permission from DPW.
- 1.2. Concrete bases shall be a minimum of 102mm (4") larger all around than the equipment and have chamfered edges. Ensure bases are level prior to placement of equipment.

### 2. Pipe Hangers and Supports

- 2.1. Provide all hangers required for the proper support of piping. Hangers shall be steel adjustable clevis type, epoxy coated or copper plated where in contact with copper piping.
- 2.2. Provide cadmium plated threaded steel rods with nuts and washers. All hanger rod installations to be double nutted (top and bottom).
- 2.3. For plumbing systems, cold pipes less than 32mm (1¼") and all hot pipes shall have line size clevis hangers. Cold pipes 32mm (1¼") and larger shall have insulation protection shields and oversized hangers with calcium silicate, Buckaroos or plastic stand-offs between the pipe and the shield.
- 2.4. Hangers to be within 30cm (12") of at least one end of each elbow. Roller hangers to be provided where expansion dictates.
- 2.5. In concrete construction, use self drilling inserts at proper centers securely anchored in concrete.
- 2.6. Beam clamps shall be used when hanging from any structural steel members. No drilling or welding of these members shall be permitted.
- 2.7. Supporting bolts shall be maximum sizes usable with the specified hanger, with adjustable and locking stop units.
- 2.8. On hot water applications, hanger pipe and structural attachments shall be offset in such a manner that hanger rods are vertical when the piping is hot.
- 2.9. All piping to be hung so that if coils, 3-way valves or pumps were disconnected or removed, pipe would remain in place without sagging or requiring additional hanging.
- 2.10. Vertical pipes shall be supported at each floor by means of iron hooks or clamp hangers placed directly below hub or fittings.

- 2.11. Install piping on spring hangers where vertical movement of the pipe is ½" or more, or the transfer of load to adjacent hangers or connected equipment is not permitted.
- 2.12. When roll grooved piping is used, any piece 122cm (48") or longer shall have a minimum of one support.
- 2.13. Spacing shall be as per the most stringent of the following requirements, code requirements and authorities having jurisdiction.

Nominal Pipe Size	Hanger Rod Diameter	Maximum Spacing: Steel	Maximum Spacing: Copper
Up to 1¼" (32mm)	3/8" (10mm)	7'-0" (2100mm)	6'-0" (1800mm)
1½" (40mm)	3/8" (10mm)	9'-0" (2700mm)	8'-0" (2400mm)
2" (50mm)	3/8" (10mm)	10'-0" (3000mm)	9'-0" (2700mm)
2½" (65mm)	3/8" (10mm)	12'-0" (3700mm)	10'-0" (3000mm)
3" (80mm)	½" (12mm)	12'-0" (3700mm)	10'-0" (3000mm)
3½" (90mm)	½" (12mm)	13'-0" (4000mm)	11'-0" (3300mm)
4" (100mm)	½" (12mm)	14'-0" (4300mm)	12'-0" (3700mm)
6" (150mm)	¾" (20mm)	17'-0" (5200mm)	
8" (200mm)	7/8" (22mm)	19'-0" (5800mm)	
10" (250mm)	7/8" (22mm)	22'-0" (6700mm)	
12" (300mm)	7/8" (22mm)	23'-0" (7000mm)	

**Note:** Horizontal drainage pipes shall be supported at intervals of not more than 152cm (5'-0") except that where 305cm (ten (10) foot) lengths of cast iron is used, it may be supported at each coupling. Plastic pipe allowed by other sections of this document (PVC, PEX, PEX-AL-PEX) shall be supported as per code.

**Section 22 05 48 Vibration and Seismic Controls for Plumbing Piping and Equipment**

1. Refer also to 13 48 00 Sound Vibration and Seismic Control for general isolation requirements.
2. Install piping on spring hangers, inertia bases, RSR pads, etc. as required to maintain low sound and vibration levels.
3. Where lateral support of pipe risers is required, it shall be accomplished by use of resilient lateral supports.
4. Pipes that penetrate the building construction shall be isolated from the building structure by use of unit resilient penetrating sleeve/seals.
5. Drain piping connected to vibration isolated equipment shall not contact the building structure or other non isolated system unless it is resiliently mounted as described above.
6. Provide flexible pipe connections in piping systems as required by other sections of this document.
7. Parallel running pipes may be hung together on a trapeze which is isolated from the building. Do not mix isolated and non-isolated pipes on the same trapeze.

## Section 22 05 53 Identification for Plumbing Piping and Equipment

### 1. Manufacturers Nameplates

- 1.1 Each piece of equipment shall have a metal nameplate mechanically fastened to equipment, with raised or recessed letters. Nameplates to be located so that they are easily read. Do not insulate or paint over plates.
- 1.2 Include registration plates (e.g. pressure vessel, Underwriters' Laboratories and CSA approval) as required by respective agency and as specified. The supplier shall indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

### 2. System Nameplates

- 2.1 Major equipment to be identified with laminated plastic plates with white face and black center (lettering) of minimum size 89mm (3½") x 38mm (1½") x 2.4mm (3/32") nominal thickness, engraved with 12.7mm (½") high lettering.
- 2.2 Nameplates to be fastened securely with pop rivets or screws in conspicuous place. Where nameplates cannot be mounted, such as on cool surfaces, provide standoffs.
- 2.3 Unique mechanical identification tag shall follow naming system laid out on drawings and in specifications. Equipment type, number and service or areas or zone of building it serves to be identified.

### 3. Equipment Concealed by Ceiling

- 3.1 At valves, balancing dampers air vents and drains, and other similar pieces of mechanical equipment located above T-bar ceilings or access doors, install circular 19mm (¾") diameter self-adhesive identification discs on the underside of the ceiling, as close as possible to the location of the equipment.
- 3.2 Discs shall be coloured as scheduled in this section (see pipe primary and secondary colours table).
- 3.3 Where the item has a primary and secondary colour, provide a 19mm (¾") diameter primary colour disc with a 9.5mm (3/8") diameter secondary colour disc centered on the primary disc.
- 3.4 Equipment located above T-bar ceilings or access doors, provide laminated plastic plates as noted for System nameplates above (with plates for fire dampers to have red face and white lettering). A second identical plate shall be installed on the underside of the ceiling grid or access door opening frame, as close as possible to the location of the equipment. System nameplates are required for backflow preventers, mixing valves and other similar pieces of equipment.

#### 4. Pipe Identification

- 4.1 Medium in piping to be identified as indicated below showing name and service, including temperature and pressure as indicated below, and directional flow arrows where relevant.
  - 4.1.1 Material shall be vinyl/plastic coated cloth with protective over coating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of 149 deg. C (300 deg. F) and intermittent temperature of 204 deg. C (400 deg. F).
  - 4.1.2 Tape shall be 51mm (2") wide single wrap around pipe or pipe covering with ends overlapping not less than 25mm (1"). Tape is to be cut, not torn.
  - 4.1.3 Block capital letters 51mm (2") high for pipes of 76mm (3") nominal and larger o.d. including insulation and not less than 19mm ( $\frac{3}{4}$ ") high for smaller diameters shall be used.
  - 4.1.4 Direction arrows 15cm (6") long by 51mm (2") wide for piping of 76mm (3") nominal or large o.d. including insulation and 102mm (4") long by 19mm ( $\frac{3}{4}$ ") wide for smaller diameters to be used. Double headed arrows to be used where direction of flow is reversible.
  - 4.1.5 Waterproof and heat resistant plastic marker tags to be used for pipes and tubing of 19mm ( $\frac{3}{4}$ ") nominal and smaller o.d.
  - 4.1.6 Use black pipe marker letters and direction arrows. Use white on red background for fire protection pipe markers.
  - 4.1.7 Stenciled identification if used shall be from a first quality low VOC paint, with letters a minimum of 51mm (2"). Use stenciling on all purpose or canvas insulation jackets only.
  - 4.1.8 A high-quality pre-manufactured identification system may be used in lieu of the identification noted above. Submit proposed product(s) to DPW and do not proceed until written approval received.
- 4.2 Location of Identification
  - 4.2.1 Markers and classifying colours on piping systems to be located so they can be seen from floor or platform.
  - 4.2.2 Piping runs to be identified at least once in each room, regardless of whether concealed or in open areas.
  - 4.2.3 Do not exceed 15m (50'-0") between identification, regardless of whether concealed or in open areas.
  - 4.2.4 In addition, where piping is concealed in pipe chase or other confined space, point of entry and leaving, and each access opening to be identified.

- 4.2.5 Both sides where piping passes through walls, partitions and floors to be identified.
- 4.2.6 Piping to be identified at starting and ending points of runs and at each piece of equipment.
- 4.2.7 Identify branch, equipment or building served after each valve. (i.e. heating zones are to be identified in boiler rooms)
- 4.2.8 Provide primary and secondary colour banding.
- 4.2.9 Identification and colour coding shall be as per the following:

Pipe Marker	Valve Tag	Primary Colour	Second Colour
Domestic (Potable) Cold Water	DCW	Green	None
Non-Potable Cold Water (paint entire line purple)	NPW	Purple	None
Domestic Hot Water Supp.	D.H.W .S.	Green	None
Domestic Hot Water Recirc.	D.H.W .R.	Green	None
Storm Sewer	S.S.	Green	None
San. Sewer	San. S.	Green	None
Fuel Oil (Show Type No.)	F.O.(No.)	Yellow	Orange
Vent (Plumbing)	V.P.	Green	None
Propane /Natural Gas (paint entire line yellow)	P.G./N.G.	Yellow	Orange
Raw Water	RAW W	Green	None
City Water	CI.W	Green	None
Distilled Water	DI.W	Green	None
Demineralized Water	DE.W	Green	None
Chilled Drinking Water Supply	D.W .S	Green	None
Drinking Water Return	D.W .R	Green	None

Pipe Marker	Valve Tag	Primary Colour	Second Colour
Treated Water	T.W	Green	None
Waste Water	W .W	Green	None
Acid Drain (Add Source)	A.D.	Yellow	Black
Isotope Drain	I.D.	Yellow	Purple
Instrument Air	I.A	Green	None
Gasoline	G	Yellow	Orange
Nitrogen	NIT	Blue	Yellow
Oxygen	OXY	Yellow	Orange
Vacuum	VAC	Green	None
Compressed Air Gauge Pressure 689kPa (100 PSI) and Lower	C.A (PSI)	Green	None
Compressed Air Gauge Pressure Over 689kPa (100 PSI)	C.A (PSI)	Yellow	Black

## 5. Valves

5.1 38mm (1½") laminated plastic plates (tags) with corner hole shall be provided for all valves and installed with nonferrous chains, "S" hooks or heavy duty plastic tie wraps. Tags shall have horizontal 12.7mm (½") letters accurately aligned and machine engraved into the core. Required for all valves and operating controllers.

5.1.1 Provide one valve chart for each Operations and Maintenance manual and one chart framed and wall mounted.

5.1.2 Valves in systems to be numbered consecutively.

## 6. Buried Pipe Identification

6.1 Use detectable Identoline underground warning tape colour coded to pipe service for full length of pipe.

6.2 Bury to manufacturers recommendations.

6.3 Identify all systems, equipment, components, controls and sensors. Inscription to identify function.

## Section 22 05 76 Facility Drainage Piping Cleanouts

### 1. Cleanouts

- 1.1. In addition to those required by code, an easily accessible cleanout shall be provided at each 135-degree change in direction in soil or waste pipe and at the base of each stack. All cleanouts shall be of the same nominal size as the pipes up to 102mm (4") and not less than 102mm (4") for larger pipes.
- 1.2. A separate cleanout in stack is required where two or more sinks or lavatories connect to a common stack.
- 1.3. Provide cleanouts to allow for complete cleaning or clearing of building plumbing system. Cleanouts shall be spaced as per the latest National Plumbing Code of Canada requirements.
- 1.4. Provide P-traps with removable dips below all sinks or drainage Y's with copper end cleanouts in trap arm piping between trap and wall or in vertical waste piping prior to the floor penetration.
- 1.5. Cleanouts are to comply to the most stringent of either code requirements or the criteria described above.
- 1.6. Cleanouts shall be complete with gas-tight expansion plug.



## Section 22 07 00 Plumbing Insulation

1. Wire, Mesh and Straps
  - 1.1. Materials
    - 1.1.1. Stainless Steel Wire: 18 ga., Type 304, dead soft annealed.
    - 1.1.2. Galvanized Wire: 15 ga., annealed.
    - 1.1.3. Stainless Steel Mesh: Hexagonal mesh, 20 ga., Type 304.
    - 1.1.4. Galvanized mesh: Hexagonal mesh, 15 ga., galvanized annealed.
    - 1.1.5. Aluminum straps: 12.7mm (½") x 26 ga.
    - 1.1.6. Stainless Steel Straps: 12.7mm (½") x 26 ga., Type 304, dead soft.
  - 1.2. Where vapour barriers are used, wire, wire mesh and straps shall be stainless steel.
  - 1.3. Where no vapour barrier is required, wire and wire mesh shall be galvanized steel. Straps may be galvanized steel or aluminum.
2. Pins; welded 4 mm diameter with 38mm (1½") diameter head for installation through insulation. Length to suit thickness of insulation.
3. Canvas: ULC listed plain weave, cotton fabric, 227g (8 oz). Finish all exposed insulation with canvas and two coats of lagging adhesive.

## Section 22 07 16 Plumbing Equipment Insulation

1. Insulate all equipment that operates at less than 15 °C (60°F) and more than 40 °C (104°F)
2. Equipment Insulation (above ambient temperature)
  - 2.1. Insulate domestic hot water tanks with 51mm (2") thick sectional semi-rigid mineral fibre, 4.5 lbs./cu. ft. See also Divisions 21 and 23).
  - 2.2. Insulation for curved surfaces shall be 51mm (2") flexible mineral fiber blanket to CAN/CGSB 51.11 (CAN/CGSB 51.11-92), or 51mm (2") thick sectional semi-rigid, as noted above.
  - 2.3. Hydrous calcium silicate insulation shall be 51mm (2 inches) thick, have a density of 208kg/m<sup>3</sup> (13 lbs./cu.ft.), and a maximum linear shrinkage of 2.2% after a 24-hour period at 649deg. C (1200 deg. F).
3. Equipment Insulation (below ambient temperature)
  - 3.1. Insulate water storage tanks and other similar pieces of equipment with 51mm (2") thick sectional semi-rigid mineral fibre, 72kg/m<sup>3</sup> (4.5 lbs./cu. ft), complete with vapour barrier jacket. See also Divisions 21 and 23.
  - 3.2. Insulation for curved surfaces shall be 51mm (2") flexible mineral fiber blanket to CAN/CGSB 51.11 (CAN/CGSB 51.11-92), or 51mm (2") thick sectional semi-rigid, as noted above, complete with vapour barrier jacket.
4. On flat surfaces, mineral fibre insulation shall be applied by impaling the insulation on 9 ga. pins, spot welded, on maximum 30cm (12") centers, and placed no closer than 4" from the edge of the board. Secure with 12.7mm (½") O.D. speed washers. Provide appropriate finish and canvas jacket.
5. On curved surfaces secure the mineral fibre insulation where indicated with galvanized steel wire or aluminum straps. Finish the insulation by applying 25mm (1") galvanized hexagonal mesh and 15 gauge galvanized annealed wire, with metal corner beads applied after the blocks are wired in place. Wire mesh shall be tightly stretched in place and secured with galvanized wire. Overlap mesh points and bind with galvanized wire. Apply one coat, not less than 6.4mm (¼") thick of hydraulic setting cement and trowel to a smooth finish. Cover with canvas neatly fitted and secured with lagging adhesive. Lap seams at least 51mm (2").
6. Calcium silicate insulation blocks shall be carefully fitted and applied with all blocks staggered. The blocks shall be secured with galvanized wire or aluminum straps.
7. Finish all exposed insulation with canvas jacket that is ULC listed, fire retardant treated, applied with an approved lagging adhesive and painted with a fire-retardant paint with a flame spread rating not greater than 25.

## Section 22 07 19 Plumbing Piping Insulation

### 1. Pipe Insulation

- 1.1. Insulate all piping that operates at less than 16 deg. C (60 deg. F) or more than 40deg. C (104 deg. F) (in floor radiant feeds less than 40deg. C (104 deg. F) do not require insulation). All piping insulation shall be jacketed, and piping/fittings/components operate at less than 16 deg. C (60 deg. F) shall have insulation with a vapour barrier jacket. Insulation and jacket material shall be suitable for the operating temperature of the pipe, for example PVC jacket on fittings would not be suitable for steam service.
- 1.2. Pipe Insulation
  - 1.2.1. Pipe insulation shall be preformed mineral fiber having a density of 64kg/m<sup>3</sup> (4 lbs./cu.ft) to CAN/CGSB 51.9-92.
  - 1.2.2. Insulation for concealed storm drainage piping may be flexible mineral fiber blanket to CAN/CGSB 51.11-92.
- 1.3. Jacketing on Pipe Insulation
  - 1.3.1. Glass fiber reinforced kraft foil laminate, all service jacket is acceptable for concealed spaces.
  - 1.3.2. Where not in concealed spaces, pipe insulation shall be canvas jacketed. Canvas jackets shall be ULC listed and labeled, fire retardant treated, applied with an approved lagging adhesive (two coats) and painted with a fire-retardant paint with a flame spread rating not greater than 25 and a smoke developed classification of not higher than 50. Minimum canvas weight shall be 0.22kg/m<sup>2</sup> (6.5 oz/sq. yd).
  - 1.3.3. Vapour barrier jackets shall be factory applied and to CGSB 51-GP-52MA.
  - 1.3.4. Provide 51mm (2") longitudinal overlap and butt joints.
  - 1.3.5. For fittings, provide flexible or premoulded insulation with canvas or PVC jacket.
  - 1.3.6. Provide removable prefabricated insulation pads c/w jacket for valves over 51mm (2"), 3-way control valves, strainers, suction diffusers, triple duty valves, heads of domestic water heater tube bundles, backflow preventers, water meters, domestic water PRVs, domestic cold water pumps.
  - 1.3.7. Jacketing on piping installed outdoors shall be aluminum.

#### 1.4. Pipe Insulation Thickness

- 1.4.1. For heating and cooling systems piping, refer to Part 5 and Table 5.2.4.3 of the Model National Energy Code for Buildings (NEBC 2015). Note that the Table includes refrigerant piping with the lines to have minimum 25 mm (1") insulation.
- 1.4.2. For domestic hot water systems, refer to Part 6 and Table 6.2.3.1 of the Model National Energy Code for Buildings (NEBC 2015). DPW's additional requirements are as follows:
- 1.4.3. All domestic hot water piping (Note 1 of this Table shall not apply) shall be insulated as per the Table,
- 1.4.4. Piping systems not covered by the Model National Energy Code but requiring insulation are as follows:
  - 1.4.4.1. Domestic cold water systems shall be provided with minimum 13 mm (½") insulation on 13 mm (½") pipe and minimum 25 mm (1") insulation on pipe 19mm (¾") and over.
  - 1.4.4.2. Storm drainage (rainwater) piping shall be provided with minimum 25 mm (1") insulation on above grade portions, including the underside of roof drain bodies.
  - 1.4.4.3. Humidifier piping to manifolds shall be provided with minimum 25 mm (1") insulation.
  - 1.4.4.4. Air conditioning unit drain lines shall be provided with minimum 13 mm (½") insulation.

#### 1.5. Installation

- 1.5.1. Pipe insulation must be kept clean and dry.
- 1.5.2. Unless specifically noted otherwise insulation shall not stop at walls and floors.
- 1.5.3. Both longitudinal and butt joints may be made with factory applied pressure sensitive vapour proof adhesive.
- 1.5.4. Gouge out insulation for proper fit where there is interference between weld bead and insulation. Insulation shall be beveled away from studs and nuts to permit their removal without damage to insulation and shall be closely and neatly trimmed around extending parts of pipe saddles, supports, hangers and clamp guides, and sealed with insulating cement.

- 1.5.5. The exposed surface, and any surface that may be exposed of any insulation assembly by cutting through material in any direction, shall have a flame spread rating not greater than 25 without evidence of continued combustion, and the insulation materials shall also have a smoke developed classification of not higher than 50 when tested in accordance with ASTM E84 (ASTM E84-19a).
- 1.5.6. If the coverings and linings are to be applied with adhesives, they shall be tested as assembled with such adhesives; or the adhesives used shall have a flame spread rating not over 25 and a smoke developed rating not higher than 50.

## Section 22 10 00 Plumbing Piping

1. All solder for drainage, vent and domestic water piping to be lead free.
2. Drainage and Vent Systems
  - 2.1. Sanitary, storm and vent pipe above grade shall be DWV copper for sizes under 51mm (2"), cast iron or DWV copper for sizes 51mm (2") and over. Cast iron shall conform to CAN B70 (CSA B70-12 (R2016)). Fittings to be same material as pipe. Mechanical joints may be used above grade. Seal between cast iron and copper shall be made with an appropriate fitting. Right angle connections in drainpipes shall be made with Y branches and 1/8 bends, the use of 90 deg. tees and elbows shall be avoided.
  - 2.2. PVC-DWV for above grade piping is also acceptable where permitted by code. PVC-DWV for above grade shall have less than 25 flame spread and not more than 50 smoke rating (example IPEX XFR-15-40). Note that PVC-DWV shall be insulated as per Facility Services Subgroup - General, Pipe Insulation.
  - 2.3. Minimum pipe size used below grade shall be 51mm (2").
  - 2.4. Sanitary pipe below grade shall be PVC-DWV or cast iron.
  - 2.5. Storm pipe below grade shall be PVC-SDR 35, PVC-DWV or cast iron.
  - 2.6. Sanitary pipe and fittings for sanitary discharges of 60°C (140°F) or higher shall be cast iron as described above. PVC is permitted if a drain cooler lowers the discharge temperature before entering the sanitary system.
  - 2.7. Joints for below grade cast iron pipe shall be hub and spigot with self locking rubber compression gaskets (Bibby Bi-Seal or equal products which require approval in writing from DPW). Mechanical joints may also be used below grade.
  - 2.8. Each fixture shall be provided with individual trap. Stacks less than 76mm (3") where carried through the roof, shall be increased to at least 76mm (3") before passing through the roof.
  - 2.9. Stacks 76mm (3") and larger shall be increased at least one size before passing through the roof.
  - 2.10. Pipe all equipment drains to floor drains so that no drainage/condensate runs across floors to floor drain locations.
  - 2.11. When connecting PVC to other types of pipe, joints shall be solvent weld or mechanical coupling.
  - 2.12. Minimum size of P-trap below grade shall be 76mm (3") (including showers).
  - 2.13. Laboratory Acid Drainage. The use of air admittance devices on plumbing systems is prohibited unless approved by provincial engineer or mechanical inspector.

2.13.1. Above ground sanitary and vent

2.13.1.1. Fittings and piping

2.13.1.1.1. Polypropylene with flame retardant

2.13.1.1.2. Borosilicate glass

2.13.1.1.2.1. Compression type stainless steel coupling with inner seal ring

2.13.1.1.2.2. Padded pipe hangers.

2.13.1.1.2.3. High silicon iron.

2.13.2. Below grade sanitary

2.13.2.1. Fittings and piping

2.13.2.1.1. Polypropylene

2.13.2.1.2. Borosilicate glass

2.13.2.1.2.1. Compression type stainless steel coupling with inner seal ring.

2.13.2.1.2.2. Padded pipe hangers

2.13.2.1.3. High silicon iron

2.13.3. Neutralization tank and sediment interceptor

2.13.3.1. High density polyethylene tank, complete with vent connection. Locate tank close to wall and arrange piping to minimize the length of horizontal vent pipe run.

2.13.3.2. 1" thick bolted cover with neoprene gasket.

2.13.3.3. Flush with floor top complete with frame ring, truss head bolts and hot sunk securing nuts.

2.13.3.4. 2.4mm (3/32") non skid prime coated steel top.

2.13.3.5. Neutralization tank

2.13.3.5.1. Initial charge plus one additional charge of limestone neutralizing chips.

2.13.3.5.2. Gasketed inspection port shall be 20cm (8").

2.13.3.5.3. Capacity shall be 250L (55 Imperial gallons) empty, 114L (25 Imperial gallons) actual.

2.13.3.5.4. Provide electronic PH monitoring system complete with wall mounted indicator adjacent to the tank.

2.13.3.6. Sediment interceptor

2.13.3.6.1. Perforated solids basket.

- 2.13.3.6.2. Basket size shall be 36cm (14") diameter by 61cm (24") high.
      - 2.13.4. Provide separate venting system (extending independently to outside) for acid drainage system.
    - 2.14. Minimum size of floor drains in mechanical rooms shall be 100mm (4"). Sizes smaller than this must be authorized by provincial mechanical engineer or inspector.
  3. Domestic Water Systems
    - 3.1. Water piping to be Type "L" copper for domestic hot, cold and recirculation systems above ground. Buried piping to be soft copper Type "K" with no buried joints. Cross linked polyethylene (PEX) pipe may be considered for run outs to individual plumbing fixtures where permitted by code (obtain specific written permission from DPW).
    - 3.2. If PEX is used it shall follow the building lines and bend supports in lieu of 90 degree fittings shall be used. Trap primer lines below grade (with no buried joints) are permitted to be PEX These materials may also be considered for above grade trap primer lines where permitted by code (obtain specific written permission from DPW).
    - 3.3. Note that PEX shall be insulated as per requirements of Facility Services Subgroup - General.
    - 3.4. Silfos solder shall be used for pipe 64mm (2½") and larger.
    - 3.5. Copper pipe 64mm (2½") and larger may be roll grooved. Grooved couplings shall be designed with angle bolt pads to provide a rigid joint, complete with EPDM flush seal gaskets. Provide unions at tanks, fixtures and other equipment.
    - 3.6. If roll groove piping system is used, all couplings and fittings shall be of the same manufacturer.
    - 3.7. Ball valves shall be used for shut-off applications 51mm (2") and smaller.
    - 3.8. Circuit balancing valves shall be used where balancing is required (e.g. on domestic water recirculation lines).
    - 3.9. Provide hose end drain with cap and chain at low points of all services piping. No water from any drain or relief valve shall discharge on floor. Pipe drains from air receivers, hot water tanks, etc., to hub drains. Where this is impractical lengths of hoses with fittings and adaptors may be used.
    - 3.10. Provide drains on all isolated domestic water branch lines serving fixtures on the second level or higher that cannot be drained through fixtures on the lowest level. Drain valves shall be minimum 2068 kPa (300psi) water rated. 19mm (¾") diameter straight pattern full port bronze ball valves, each



complete with a threaded outlet suitable for coupling connection of 19mm (3/4") diameter garden hose, and a cap and chain. Drain valve to be lead free.

- 3.11. Only lead-free bronze or brass valves, strainers, etc. shall be used on the complete water system (starting at the first valve of the incoming water).
- 3.12. Valves shall be installed at all mains and at all branches.

#### 4. Piping Installation

- 4.1. Install pipe straight, parallel to building lines, and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes. The water supply mains shall generally run near the ceiling of the lowest story.
- 4.2. Install groups of piping parallel to each other; spaced to permit application of insulation, identification, and service access, on trapeze hangers.
- 4.3. Prohibited Locations: No water piping shall be placed in floor fills, structural slabs over ornamental suspended ceilings, in transformer vaults, electrical or server rooms, or over switch boards or electrical panels.
- 4.4. Where pipe sizes differ from connection sizes of equipment, install reducing couplings close to equipment. Reducing bushings are not permitted.
- 4.5. Brass and copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.
- 4.6. Ream ends of pipes and tubes before being made up.
- 4.7. Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- 4.8. Use non-corrosive lubricant or Teflon tape applied to male thread.
- 4.9. Cut grooved pipe ends square, with seating surface clean and free from indent and score marks.
- 4.10. Install di-electric couplings wherever piping of dissimilar metals are joined.
- 4.11. Install swing or swivel joints to connect risers to mains.
- 4.12. All piping shall be run concealed in pipe spaces, chases and ceiling spaces where practical. Piping that is run exposed in finished areas shall be located in corners and furred in under work of the appropriate section for indicated furring.
- 4.13. Transition from plastic to copper or cast iron to take place not further than 76mm (3") above slab.
- 4.14. Wipe all pipes of soldering flux as the joint is completed.
- 4.15. A circuit balancing valve and check valve shall be installed in each recirculation branch or riser before joining the main.

- 4.16. Return circulating pipes: Required where domestic hot water supply pipe or pipes exceeds 15m (50 feet). Include balancing valves and check valves to ensure that flow is one way only.
- 4.17. All drainage mains below grade shall be run at minimum 2% slope.
- 4.18. See Refer to Facility Services Subgroup - General (FSS-G) for testing requirements.
5. Expansion Compensators
  - 5.1. Install in accordance with manufacturer's recommendations.
  - 5.2. Provide anchors to control the direction and extent of pipe movement.
  - 5.3. Provide guides in accordance with manufacturer's recommendations.
  - 5.4. Where space permits, provide expansion loops in lieu of compensators.
6. Mechanically Formed Tee Connections
  - 6.1. Mechanically formed tee connections shall be permitted for use on copper tube water systems in type L copper.
  - 6.2. Mechanically extracted collar shall be formed in continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of a tube wall. The collaring device shall be fully adjustable to ensure proper tolerance and complete uniformity of the joint.
  - 6.3. The branch shall be notched to conform with the inner curve of the run tube, dimpled to ensure penetration of the branch tube into the collar is of sufficient depth for brazing and that the branch tube does not obstruct the flow in the main line tube.
  - 6.4. All joints shall be soldered.
  - 6.5. All mechanically formed branch collars shall be listed or approved by the appropriate National, Provincial or Municipal codes in addition to the Underwriters Laboratory.
  - 6.6. Tee connections can be used on one (1) inch and above water pipe and where the branch line connection to the branch main is at least one (1) pipe size smaller than the branch main.

## Section 22 11 00 Facility Water Distribution

### 1. General

- 1.1. Unless otherwise required by the program, the domestic hot water service shall be nominal 50°C (120°F) (except as noted in .2 below) and available at all fixtures in the building at all times. Water shall be maintained at a minimum of 60 deg. C (140 deg. F) in the storage device and mixed down to 49 deg. C (120 deg. F).
- 1.2. Water supplied to kitchens (dishwashers and pot sinks only), laundries and other designated areas shall be nominal 60°C (140°F).
- 1.3. Provide domestic hot water recirculation where hot water supply pipe or pipes exceeds 15m (50 feet). Use of electric domestic hot water heaters located at remote spaces in lieu of the central domestic hot water system with recirculation shall not be allowed, unless permission is obtained in writing from DPW.

### 2. Water Hammer

- 2.1. Air chambers sized in accordance with branch pipe size and length, water velocity and flow pressure may be provided if provision is made for recharging by including an isolation valve, hose bibb and pet cock. Otherwise water hammer arresters shall be used. Install one or more per each group of fixtures as recommended.
- 2.2. Water hammer prevention devices shall be sized and shown on the plumbing drawings.

### 3. Plumbing Specialties

- 3.1. All plumbing specialties (other than gaskets) shall be metallic. Exposed metal parts in finished areas shall be chrome plated or stainless steel. Exposed non-metal parts shall be sprayed painted silver/aluminum.

### 4. Vacuum Breakers

- 4.1. Provide on domestic cold water supply to domestic hot water tanks.

### 5. Backflow Preventers

- 5.1. Protect the entire water distribution system against contamination due to backflow from non-potable sources. Provide a single reduced pressure type backflow preventer for services up to 51mm (2") and two reduced pressure type backflow preventers for services larger.
- 5.2. Provide each connection to fixtures or equipment for which approved air gap or vacuum breaker is not shown, or specified elsewhere with the fixture or

equipment itself, with a reduced pressure type backflow preventer (and dump valve). Discharge shall be piped to a drain.

5.3. All reduced pressure backflow preventers installed in a location where the line pressure is alternately decreasing and increasing (e.g. deep well with storage tanks) shall be complete with a check valve in the supply piping to the backflow preventer. The backflow preventer shall be designed to dump when reverse flow occurs.

5.4. Refer to AWWA manual for cross connection control.

## 6. Backwater Valves

6.1. Fixtures shall be protected with an accessible backwater valve or shutoff valve where required (only those below the level of the street service shall be protected). Backwater valves shall comply with the latest National Plumbing Code of Canada.

## 7. Wall Hydrants and Hose Bibbs

7.1. Shall have thread spout, replaceable composition disc, bronze construction, chrome plating and be complete with backflow protection.

7.2. Wall hydrants shall be installed so that any part of the exterior of the building may be reached with 30m (100 feet) of hose without having the hose across the entrance to the building. Wall hydrants shall be of the non-freeze, self-draining type (except for gymnasium areas where the non-freeze portion would protrude into the gym space) and shall be vandal proof.

7.3. Provide hose bibbs in machine rooms, boiler rooms and vehicle sally ports.

## Section 22 11 23 Domestic Water Pumps

### 1. General

- 1.1. Pumps shall be centrifugal type with quiet operating characteristics and maximum speed of 1750 rpm. Pumps shall have mechanical seals and sleeve bearings.
- 1.2. A flat curve pump selected slightly to left of midpoint of pump capacity curve is recommended. A steep curve pump can be considered if the system has high head loss terminal unit sub-circuits and no modulating valves.
- 1.3. Pump motors shall be non-overloading over published rating curve.
- 1.4. Pump construction shall permit complete servicing without disassembly of piping or motor connections. Pump connections shall be flanged.
- 1.5. All base mounted and vertical in-line centrifugal pumps shall be mounted on housekeeping pads as per Section 13 48 00.
- 1.6. Where lift is required of pumps, variable frequency drives and booster pumps shall not be used.

### 2. Base Mounted Pumps

- 2.1. Base mounted pumps to be equipped with water-tight, long-life, self-lubricating mechanical seals. The pumps shall be of the end-suction, radially split casing type of center-line discharge design with back pull-out feature permitting removal of the complete rotating assembly without disturbing pipe connections. Pump construction shall be bronze-fitted suitable for a maximum working pressure of 1308kPa (175 psig). The pump shafts shall be supported by two heavy duty ball bearings. Casing gasket shall be confined within pump casing. Pumps shall be complete with bronze impeller and stainless-steel shaft.
- 2.2. The driving motor shall be of the squirrel-cage induction type with ODP enclosure. Pump and motor to be mounted on a rigidly constructed fabricated steel base plate and directly connected through a flexible coupling protected by a guard.
- 2.3. With each pump, provide a suction guide with cast iron body, outlet guide vanes, removable stainless-steel strainer with c" diameter holes and a fine mesh brass start-up strainer. Each suction guide size to be selected to match each pump suction flange size and rating. Where guide flange on pipe side does not meet pipe size, provide necessary increaser. Strainers to be periodically inspected during start-up of the system and the fine mesh brass strainer removed after the system is fully operational. Space shall be provided for the removal of the strainer and connection of a blow-down valve.

- 2.4. Each pump shall be provided with a triple duty control valve (smaller pumps can be provided with a check valve and circuit balancing valve). Bodies shall be arranged with right angle inlet connections to permit mounting in horizontal or vertical position to suit piping arrangement (straight type permitted where manufacturer doesn't approve angle type for horizontal stem mounting). Bodies shall be drilled both ends for ASA 57kg (125 lb).
  - 2.5. Provide three (3) roll grooved joints or flexible connectors at each pump connection. These joints or connectors shall be within 183cm (six (6) feet) of the pump on both the inlet and outlet sides.
  - 2.6. Drip ledge bases shall be piped to the nearest floor drain.
  - 2.7. Upon satisfactory pump alignment, base shall be filled with grout and, after hardening, anchor bolts shall be tightened and alignment rechecked and, if necessary, corrected by the use of shims.
3. Vertical Pumps
    - 3.1. Pumps shall be vertical in-line centrifugal pumping units with back pull-out feature. Pumps shall have cast iron casing with equal size suction and discharge flanges, separate tapped flush line and pressure gauge connections, bronze dynamically balanced impeller, stainless steel shaft, lower carbon throttle bushing, outside type balanced mechanical seal with rotating face, stationary seat and Viton secondary seal.
    - 3.2. The pump is to be fitted with a factory installed flush line.
    - 3.3. Supply in the flush line to the mechanical seal, a 50 micron cartridge filter (alternatively, a cyclone separator when pump differential pressure exceeds 308kPa (30 psig)) and floating ball type sight flow indicator suitable for the working pressure encountered.
    - 3.4. The driving motor shall be an industry standard, vertical solid shaft, squirrel cage induction type, P-base, with open drip-proof enclosure and shall be connected to the pump through a high tensile aluminum, split type spacer coupling to permit servicing of the mechanical seal without disturbing pump, motor or electrical wiring. The coupling shall be protected by a guard.
  4. In-Line Circulator Pumps
    - 4.1. Horizontal mount, centrifugal, close coupled, mounted in-line. Casing shall be cast iron except bronze casing for domestic hot and cold water services. Impeller shall be bronze or cadmium plated steel. Shaft shall be carbon steel alloy with integral thrust collar. Bearings shall be bronze with spiral grooves to convey lubricant the entire length of the bushing. Seals shall be spring loaded carbon rotating washer complete with rubber bellow held against a stationary floating stellite seat and seat ring.

## Section 22 13 00 Facility Sanitary Sewer

### 1. Grease Interceptors

- 1.1. For kitchens, provide grease interceptors complying with the latest National Plumbing Code of Canada. Where feasible, locate outside of kitchens. Interceptors to be of metal construction and complete with non-skid secure cover and gasket, white exterior and acid resistant interior enamel finish for mounting flush with floor. Each interceptor shall have flow control fitting suitably vented; metal thickness shall be not less than 5mm (3/16"). Provide a vent on the downstream side of the interceptor. Interceptors shall be the enzymatic type.
- 1.2. Install necessary extension pieces on grease interceptors recessed in the floor to bring the cover flush with the floor.
- 1.3. Where interceptors are installed below counters or equipment, locate so that top is removable for cleaning purposes.
- 1.4. Dishwashers shall not discharge into grease interceptors.

### 2. Garage Oil Interceptors

- 2.1. For vehicle garages, use an oil and sludge interceptor with removable but secure locked covers.

### 3. Drains

- 3.1. Floor Drains - Minimum outlet and drain line size from floor drains shall be 76mm (3"). Trap primers are required on all floor drains. Trap primers are also required for other drains where loss of trap seal will occur through evaporation. Use deep-seal traps and flashing clamps where required.
- 3.2. Hub Drains - Minimum outlet and drain line size from hub drains shall be 76mm (3"). Preference shall be given to combination funnel floor drains. Use screwed-in-hub to at least 51mm (2") above floor level with bodies and traps as for floor drains in equipment areas.
- 3.3. Floor drains located in boiler rooms may be ganged together into a running trap at the exit from the room.
- 3.4. Finished areas - Cast iron body complete with adjustable strainer, nickel bronze top, integral seepage flange, 13mm (1/2") seal primer tapping.
- 3.5. Unfinished areas - Cast iron, Dura coated complete with dome strainer, cast iron top, integral seepage flange, 13mm (1/2") seal primer tapping.
- 3.6. Holding cells shall incorporate a flushing floor drain with a hose bibb installed outside the cell. All floor drains located in areas occupied and/or attended by the inmates shall have secured type grates.

4. Pipe Line Strainer
  - 4.1. Screwed iron body with adaptor for soldered copper tubing, brass screws and standard perforation 0.8mm (1/32") holes.
5. Trap Seal Primers
  - 5.1. All trap seal primers shall be electronic complete with manual test button. Trap primers shall have 13mm (½") manifold connections, 24-hour timer vacuum breaker, galvanized steel box with prime coated access door, 120 volt single point power connection, and water hammer arrestor.
6. Cleanouts
  - 6.1. Refer to Section 22 05 76 Facility Drainage Piping Cleanouts.



## Section 22 14 00 Facility Storm Drainage

1. Roof Drains
  - 1.1. Where municipality requires controlled run-off, coordinate ponding and weir type roof drains with architect.
  - 1.2. Make provision for rainwater leader thermal expansion. Pay particular attention when the piping is PVC-DWV.
  - 1.3. Roof drain domes to be aluminum or cast iron.

## Section 22 40 00 Plumbing Fixtures

### 1. General

- 1.1. Vitreous china plumbing fixtures shall be white and the product of one manufacturer.
- 1.2. Stainless steel plumbing fixtures shall be the product of one manufacturer
- 1.3. Trim shall be of one manufacturer and heavy-duty pattern for institutional use (Delta Commercial - Teck Institutional or equal products which require approval in writing from DPW).
- 1.4. Provide concealed chair carriers for wall mounted fixtures. Heavy duty mounting brackets fastened from the back side of the wall are acceptable for urinals where they are mounted on concrete block walls.
- 1.5. Exposed plumbing brass and metal work shall be heavy triple chromium plated.
- 1.6. Provide union connections at all faucets.
- 1.7. Note that other project requirements may mean modification of the items listed below with additional features and/or limitations. For example, barrier free and energy related (MNECB, LEED, Climate Change Action Plan etc.) requirements may necessitate the use of certain fixtures and/or trim. Mechanical design engineer to consult with DPW.

### 2. Water Closets

- 2.1. Water closets shall be vitreous china, wall mounted in all areas.
- 2.2. All water closets shall have siphon jet bowl and elongated rim except for educational facility primary classroom washrooms where water closets to have regular rim.
- 2.3. All water closets shall have white, solid plastic, open front seats with antibacterial properties. Barrier free water closets shall have covers for seats.
- 2.4. Flush valves for water closets shall be manual, exposed, with oscillating handle.
- 2.5. For educational facilities, tanks may be used in staff washrooms and, if necessary, in public (student) washrooms where the available water service is unsuitable for flush valves. Where tanks are used rather than flush valves, tanks shall be lined to prevent sweating. Provide bolt down covers on tanks in all areas except in staff washrooms.
- 2.6. Water closets shall be low flow type (4.8 litres/flush).

3. Urinals

- 3.1. Urinals shall be vitreous china, washout, wall mounted type, flushing rim, integral extended shields, removable SS strainer. Trap water level shall not be above strainer.
- 3.2. Urinal wastes to be cast iron from 30cm (12") above overflow to main branch waste, with hard type K copper outlet connection through wall. Urinal wastes may also be PVC-DWV plastic.
- 3.3. Flush valves for urinals shall be electronic and wired to building electrical system (not battery powered).

4. Flush Valves

- 4.1. Water pressure at flush valves shall be 172 to 414 kPa (25 to 60 psi) (the water system shall maintain a minimum pressure of 172 kPa (25 psi) at all flush valves in the building, including during times of peak usage)
- 4.2. Where concealed valves are used, provide access for service.

5. Lavatories

- 5.1. Vitreous China - Wall mounted type, rectangular, splash lip and overflow (overflow must not be exposed such that it could be vandalized)
- 5.2. Countertop - Self rimming, stainless steel, overflow, seal to be putty, caulking or concealed vinyl gasket (undercounter mount also acceptable). For educational facilities, provide protective skirts under lavatories to prevent vandalism to overflow pipes and other components.

6. Fixture Carriers

- 6.1. Select carriers to support fixtures without strain on piping. Supports shall be such that 91 kg (200 lb). weight will not loosen or distort mounting. Stronger supports may be required in health care for bariatric patients.

7. Service and Mop Sinks

- 7.1. Floor mounted molded stone mop service basin c/w stainless steel back and suitable trim.

8. Stainless Steel Sinks

- 8.1. Type 302 SS, self-rimming, single or double compartment with undercoating, crumb cups, holes drilled in ledgeback.
- 8.2. Chrome plated supply with swing spout, aerator, two indexed metal handles. Provide retractable spray in staff rooms.

9. Emergency Fixtures

- 9.1. All emergency fixtures (eye/face wash and combination shower eye/face wash stations etc.) shall be supplied with tempered water via an adjustable temperature mixing valve.

10. Fixture Installation

- 10.1. Connect fixtures complete with supplies and drains, separately trapped, supported level and square. Each fixture shall have shut-off valve and union connections on supplies. Threaded IPS connections on inlet to fixture shut off shall be used. 5/8" compression valves are not to be used as isolation valves for fixtures. Soldered connections are also not permitted.
- 10.2. Hot water faucets shall be on left. Mixing faucets shall have opposite action and pressure balanced mixing valves shall have check valves on supplies. Fixtures on outside walls shall have supplies from floor; other fixtures shall be serviced from wall.
- 10.3. Exposed piping, valves and metal to vitreous china fixtures shall be chrome plated with plated escutcheons. Exposed piping, valves and metal to stainless steel fixtures shall be spray painted chrome, if not chrome plated.
- 10.4. Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.
- 10.5. All joints between plumbing fixtures and walls or floors are to be caulked.
- 10.6. Braided and plastic supplies shall not be used.
- 10.7. For equipment supplied by others, provide rough-in complete with valved supplies, wastes and vents, capped.

**END**

## **DIVISION 23 - HEATING, VENTILATING, and AIR-CONDITIONING (HVAC)**

### **Section 23 00 00 HVAC – General**

1. Refer also to Facility Services Subgroups - General, for additional HVAC requirements and Common Work Results for mechanical systems.
2. Varying, or deviating from any item(s) indicated in this document must be approved by DPW. DPW will not grant a deviation from these requirements unless the deviation has been submitted in writing for review and approved prior to proceeding with the design.
3. Mechanical designer shall inspect all air handling units and air distribution systems for cleanliness prior to start-up of systems. No systems shall be started until they are cleaned to satisfaction of the designer and until filters (temporary or permanent) are in place. Air handling systems shall not be run until construction activities are complete and the building is clean and dust free (this is when testing and commissioning may commence).
4. Building circulators are not to be used for flushing and cleaning of system. Flush connections shall be added on either side of pump.
5. Commissioning, Testing and Balancing shall be as per related Facility Services Subgroup- General (FSS-G) requirements.
6. Building Flush-Out
  - 6.1. The entire building shall be flushed out utilizing building ventilation systems set to maximum outside air settings for a calculated period of time to comply with the latest green building certification program (as applicable) after all construction has been completed and furniture has been installed prior to occupancy.

## Section 23 05 00 Common Work Results for HVAC

### 1. Roll Grooved Joints

#### 1.1. General

##### 1.1.1. References

###### 1.1.1.1. American Water Works Association (AWWA)

1.1.1.1.1. ANSI/AWWA C111/A21.11-(00) (AWWA C111/A21.11-17), Rubber Gasket Joints for Ductile-Iron and Fittings.

1.1.1.1.1.1. CSA B242-M1980(R1998) (CSA B242-05 (R2016), Groove and Shoulder Type Mechanical Pipe Couplings.

##### 1.1.2. Maintenance

###### 1.1.2.1. Extra materials

1.1.2.1.1. Provide the following spare parts:

1.1.2.1.1.1. Gaskets for flanges: one for every ten flanges.

#### 1.2. Products

##### 1.2.1. Pipe Joints

1.2.1.1. Roll grooved: to CSA B242 (CSA B242-05 (R2016)).

1.2.1.2. Roll grooved: Joints to be rigid with angled bolt pads for rigidity and visual verification of sealed joint, except at expansion loops, elbows and pumps where flexible couplings shall be used.

1.2.1.3. Roll grooved products shall be of one manufacturer and have CRNS for Nova Scotia.

##### 1.2.2. Fittings

1.2.2.1. Fittings for roll grooved piping malleable iron to ASTM A47/A47M (ASTM A47/A47M-99(2018)e1) on ductile iron to ASTM A536 (ASTM A536-84(2019)e1).

##### 1.2.3. Gaskets

1.2.3.1. Roll grooved couplings gaskets: type EPDM

1.2.3.2. Gaskets shall be good for cold and hot water up to minimum 110deg C (230deg F)

1.2.3.3. Gaskets for other services require approval in writing from DPW

1.2.4. Valves

1.2.4.1. Connections

1.2.4.1.1. DN 65 (NPS 2 ½) and larger:

1.2.4.1.1.1. Grooved ends: as specified.

1.2.4.2. Butterfly valves: Application: Isolating equipment:

1.2.4.2.1. DN 65 (NPS 2 ½) and larger:

1.2.4.2.1.1. Grooved ends: as specified.

1.2.4.3. Swing check Valves: to MSS-SP-71 (MSS SP-71-2018).

1.2.4.3.1.1. DN 65 (NPS 2 ½) and larger:

1.2.4.3.1.2. Grooved ends: as specified.

1.2.4.4. Silent check valves.

1.2.4.4.1. DN 65 (NPS 2 ½) and larger:

1.2.4.4.1.1. Grooved ends: as specified.

1.2.4.5. All valves shall be lead free.

## Section 23 05 19 Meters and Gauges for HVAC Piping

1. Thermometers and Pressure Gauges
  - 1.1. Thermometers
    - 1.1.1. Adjustable type 23cm (9") graduated scale, metal casing, calibrated in degrees F and degrees C range to suit the normal operating temperature of the fluid.
    - 1.1.2. Locate and install thermometers to facilitate reading.
    - 1.1.3. For heating systems, provide thermometers at the inlet and outlet of all main heat exchange equipment (for exchangers/convertors in both primary and secondary piping), programmed water three way valves, heating coils and cooling coils and on the supply and return piping (in the boiler room and/or chiller room ) for main heating and cooling zones.
  - 1.2. Pressure Gauges
    - 1.2.1. Gauges shall be 114mm (4½") diameter, cast aluminum, close type black finished ring and clear glass window, calibrated in both imperial and metric. Dials shall have white finish with jet black embossed figures and graduations.
    - 1.2.2. Permanent legibility shall be ensured by a hot dip stamp process. The pointer shall be adjustable, black finish with red tip.
    - 1.2.3. Movement shall be bronze with bronze bushing. The bourdon tube shall be phosphor bronze soldered to the socket and tip.
    - 1.2.4. Accuracy to be 1% over middle half of scale range and 1½% over balance. All gauges to be complete with snubbers and mini ball valves. Gauges on steam systems shall be complete with mini ball valves and pipe siphon.
    - 1.2.5. Locate and install pressure gauges to facilitate reading.
    - 1.2.6. For heating systems, provide gauges for each pump over ½ hp, at the inlet and outlet of all main heat exchange equipment (for exchangers/convertors in both primary and secondary piping) including heating and cooling coils, and on both sides of water make- up assemblies.



**Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment**

1. Duct hangers and supports shall follow the recommendations of the SMACNA Duct Manuals.
2. Provide all hangers required for the proper support of ducting. Hangers shall be galvanized or primed steel channel or angle sections. To adjust the duct height, provide cadmium plated threaded steel rods with nuts and washers. All hanger rod installations to be double nutted (top and bottom).
3. For ducts 500 mm (20") and smaller, 25 mm (1") wide strap hangers are acceptable.
4. In concrete construction, use self drilling inserts at proper centers securely anchored in concrete.
5. Beam clamps shall be used when hanging from any structural steel members. No drilling or welding of these members shall be permitted.
6. Do not break continuity of duct insulation vapour barrier with hangers or rods.

### Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment

1. Aim of noise and vibration control shall be to ensure that mechanical equipment and systems operate at the lowest sound and vibration level consistent with the functional requirements of the project.
2. Moving Machinery
3. Moving machinery shall be set on foundations isolated from the structure so as to minimize the transmission of noise and/or vibration.
4. Heavy reciprocating machinery shall be located on the lowest level of the building. Where it must be located on a framed floor, very careful attention shall be given to the proper balancing of the masses of the foundation and the supporting structure, and also to the design of the isolation equipment.
5. Major Equipment Isolation
6. Flexible pipe and duct connections shall be installed at all pipe and duct connections to vibration isolated equipment (not required if equipment internally isolated). Three (3) roll grooved joints may be used in lieu of flexible pipe connectors. See Flexible Connections in Ductwork Accessories section for further information on flexible duct connections.
7. All fans and pumps shall be isolated from the building structure.
8. A/H units (not required if internally isolated), base mounted pumps, air compressors over 5 hp, and chillers shall be isolated from the building structure by means of spring isolators and an inertia base. Other types of isolation (in accordance with manufacturer's recommendations) may be considered but will be allowed only with written permission from DPW.
9. Air compressors up to and including 5 hp shall be isolated from the building structure by means of spring isolators.
10. Electrical connections to vibration isolated equipment shall be flexible.
11. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the equipment shaft.

## Section 23 05 53 Identification for HVAC Piping and Equipment

1. Manufacturers Nameplates
  - 1.1. Each piece of equipment shall have a metal nameplate mechanically fastened to equipment, with raised or recessed letters. Nameplates to be located so that they are easily read. Do not insulate or paint over plates.
  - 1.2. Include registration plates (e.g. pressure vessel, Underwriters' Laboratories and CSA approval) as required by respective agency and as specified. The supplier shall indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.
2. System Nameplates
  - 2.1. Major equipment to be identified with laminated plastic plates with white face and black center (lettering) of minimum size 89mm x 38mm x 2mm (3½" x 1½" x 3/32") nominal thickness, engraved with 13mm (½") high lettering.
  - 2.2. Nameplates to be fastened securely with pop rivets or screws in conspicuous place. Where nameplates cannot be mounted, such as on cool surfaces, provide standoffs.
  - 2.3. Unique mechanical identification tag shall follow naming system laid out on drawings and in specifications. Equipment type, number and service or areas or zone of building it serves to be identified.
3. Equipment Concealed by Ceiling
  - 3.1. At valves, balancing dampers air vents and drains, and other similar pieces of mechanical equipment located above T-bar ceilings or access doors, install circular 19mm (¾") diameter self-adhesive identification discs on the underside of the ceiling, as close as possible to the location of the equipment.
  - 3.2. Discs shall be coloured as scheduled in this section (see pipe primary and secondary colours table).
  - 3.3. Where the item has a primary and secondary colour, provide a 19mm (¾") diameter primary colour disc with a 9.5mm (3/8") diameter secondary colour disc centered on the primary disc.
  - 3.4. For backflow preventors, fire dampers, air terminal units, exhaust fans, reheat coils and other similar pieces of equipment located above T-bar ceilings or access doors, provide laminated plastic plates as noted for System nameplates above (with plates for fire dampers to have red face and white lettering). A second identical plate shall be installed on the underside of the ceiling grid or access door opening frame, as close as possible to the location of the equipment.
4. Pipe Identification

- 4.1. Medium in piping to be identified as indicated below showing name and service, including temperature and pressure as indicated below, and directional flow arrows where relevant.
- 4.2. Material shall be vinyl/plastic coated cloth with protective over coating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of 149 deg. C (300 deg. F) and intermittent temperature of 204 deg. C (400 deg. F).
- 4.3. Tape shall be 51mm (2") wide single wrap around pipe or pipe covering with ends overlapping not less than 25mm (1"). Tape is to be cut, not torn.
- 4.4. Block capital letters 51mm (2") high for pipes of 76mm (3") nominal and larger o.d. including insulation and not less than 19mm ( $\frac{3}{4}$ ") high for smaller diameters shall be used.
- 4.5. Direction arrows 152mm (6") long by 51mm (2") wide for piping of 76mm (3") nominal or large o.d. including insulation and 102mm (4") long by 19mm ( $\frac{3}{4}$ ") wide for smaller diameters to be used. Double headed arrows to be used where direction of flow is reversible.
- 4.6. Waterproof and heat resistant plastic marker tags to be used for pipes and tubing of 19mm ( $\frac{3}{4}$ ") nominal and smaller o.d.
- 4.7. Use black pipe marker letters and direction arrows. Use white on red background for fire protection pipe markers.
- 4.8. Stenciled identification if used shall be from a first quality low VOC paint, with letters a minimum of 51mm (2"). Use stenciling on all purpose or canvas insulation jackets only.
5. A high-quality pre-manufactured identification system may be used in lieu of the identification noted above. Submit proposed product(s) to DPW and do not proceed until written approval received.
6. Location of Identification
7. Markers and classifying colours on piping systems to be located so they can be seen from floor or platform.
8. Piping runs to be identified at least once in each room, regardless of whether concealed or in open areas.
9. Do not exceed 1524cm (50'-0") between identification, regardless of whether concealed or in open areas.
10. In addition, where piping is concealed in pipe chase or other confined space, point of entry and leaving, and each access opening to be identified.
11. Both sides where piping passes through walls, partitions and floors to be identified.

12. Piping to be identified at starting and ending points of runs and at each piece of equipment.
13. Identify branch, equipment or building served after each valve. (ie. heating zones are to be identified in boiler rooms)
14. Provide primary and secondary colour banding.
15. Identification and colour coding shall be as per the following:

Pipe Marker	Valve Tag	Primary Colour	Second Colour
Glycol Supply	G.S.	Yellow	Black
Glycol Return	G.R.	Yellow	Black
Condenser Water Supply	CONDS.W .S	Green	None
Condenser Water Return	CONDS.W .R	Green	None
Chilled Water Supply	CH.W .S	Green	None
Chilled Water Return	CH.W .R	Green	None
Chilled Drinking Water Supply	D.W .S	Green	None
Hot Water Heating Supply (Up to 120 deg. C)	H.W .H.S	Yellow	Black
Hot Water Heating Return (Up to 120 deg. C)	H.W .H.R	Yellow	Black
Hi Temp Water Supply (Above 120 deg. C)	H.T.W .S.	Yellow	Black
Hi Temp Water Return (Above 120 deg. C)	H.T.W .R	Yellow	Black
Make Up Water	M .U.W	Yellow	Black
Boiler Feed Water	B.F.W	Yellow	Black
Condensate Return	C.R	Yellow	Black
Blow Off	B.O	Yellow	Black
Refrigerant Suction (Include Refrig No.)	REF.S (No.)	Yellow	Black
Refrigerant Liquid (Include Refrig No.)	REF.L (No.)	Yellow	Black
Refrigerant Hot Gas (Include Refrig No.)	REF.H.G. (No.)	Yellow	Black

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Pipe Marker	Valve Tag	Primary Colour	Second Colour
Engine Exhaust		Yellow	Black
Steam (Indicate Pressure)	S (PSI)	Yellow	Black
Vent (Steam)	V	Yellow	Black

## 16. Valves

16.1. 38mm (1½") laminated plastic plates (tags) with corner hole shall be provided for all valves and installed with nonferrous chains, "S" hooks or heavy duty plastic tie wraps. Tags shall have horizontal 13mm (½") letters accurately aligned and machine engraved into the core. Required for all valves and operating controllers.

16.1.1. Provide one valve chart for each Operations and Maintenance manual and one chart framed and wall mounted.

16.1.2. Valves in systems to be numbered consecutively.

## 17. Buried Pipe Identification

17.1. Use detectable Identoline underground warning tape colour coded to pipe service for full length of pipe.

17.2. Bury to manufacturers recommendations.

17.3. Identify all systems, equipment, components, controls and sensors. Inscription to identify function.

## 18. Duct Identification

18.1. 51mm (2") high black stenciled letters to be used, i.e. "Supply", "Return", "Exhaust", "Washroom Exhaust", "Kitchen Exhaust", etc. with directional flow arrow and Fan System No.

18.2. Maximum distance between markings not to exceed 1524cm (50'-0").

18.3. Locate identification on long straight runs in boiler and equipment rooms so that at least one is clearly visible from any one viewpoint in usual operating areas or walking aisles, adjacent to all changes in direction, at least once in each room, on both sides of visible obstructions, on both sides of walls, floors and partitions, at each piece of equipment and beside each access door.

18.4. Stencil over final finish only.

18.5. Identify system to include air handling unit number.

## Section 23 07 00 HVAC Insulation

1. Wire, Mesh, and Straps
  - 1.1. Materials
    - 1.1.1. Stainless Steel Wire: 18 ga., Type 304, dead soft annealed.
    - 1.1.2. Galvanized Wire: 15 ga., annealed.
    - 1.1.3. Stainless Steel Mesh: Hexagonal mesh, 20 ga., Type 304.
    - 1.1.4. Galvanized mesh: Hexagonal mesh, 15 ga., galvanized annealed.
    - 1.1.5. Aluminum straps: 13mm (½") x 26 ga.
    - 1.1.6. Stainless Steel Straps: 13mm (½") x 26 ga., Type 304, dead soft.
  - 1.2. Where vapour barriers are used, wire, wire mesh and straps shall be stainless steel.
  - 1.3. Where no vapour barrier is required, wire and wire mesh shall be galvanized steel. Straps may be galvanized steel or aluminum.
2. Pins; welded 4 mm diameter with 13mm (½") diameter head for installation through insulation. Length to suit thickness of insulation.
3. Canvas: ULC listed plain weave, cotton fabric, 8 oz. Finish all exposed insulation with canvas and two coats of lagging adhesive.

## Section 23 07 13 Duct Insulation

1. Provide 1" thick duct insulation on the following:
  - 1.1. Dual temperature and air conditioning supply duct.
  - 1.2. Ducts which pass through unconditioned areas and ducts where the temperature difference between the space where the duct is located and the design air temperature of the air carried by the duct exceeds 9<sup>0</sup>F (5<sup>0</sup>C) Also to be insulated are ducts running outdoors, including those for dust collection systems. All duct insulation thicknesses to be in accordance with MNECB requirements.
    - 1.2.1. Exhaust ducts (except kitchen exhaust) are to be insulated 305cm (10") back from their point of exit from the building.
2. Insulation shall be 51mm (2") thick on air handling unit outside air intake ducts and plenums and exhaust plenums, as well as outside air intakes for both boiler rooms and electrical rooms Also to have 51mm (2") insulation are exhaust ducts from air handling unit heat recovery devices which are to be insulated completely from the heat recovery devices to the exhaust plenum.
3. Duct Insulation type - Rigid / Flexible
4. Rigid duct insulation shall be used on exposed rectangular ducts. Flexible duct insulation may be used on rectangular ducts in concealed spaces, such as above ceilings and in wall cavities. Flexible duct insulation shall also be used on round ducts.
5. Rigid insulation shall be rigid mineral fibre board, having a minimum density of 96 kg/m<sup>3</sup> (6 lbs./cu.ft) to CAN/CGSB-51.10 (CAN/CGSB-51.10-92).
  - 5.1. Flexible insulation shall be flexible mineral fibre blanket to CAN/CGSB-51.11 (CAN/CGSB-51.11-92).
6. Jacketing on Duct Insulation
7. Factory applied foil-scrim-kraft facing consisting of aluminum foil reinforced with fibre glass yarn mesh and laminated to chemically treated fire resistant kraft is acceptable for duct insulation in concealed spaces.
8. Glass fiber reinforced kraft foil laminate, all service jacket is acceptable for concealed spaces.
9. Canvas jackets shall be ULC listed, fire retardant treated, applied with an approved lagging adhesive (two coats) and painted with a fire retardant paint with a flame spread rating not greater than 25. Where not in concealed spaces, duct insulation shall be canvas jacketed.
10. Jacketing on ducting installed outdoors shall be aluminum.



11. Installation
12. Insulation shall be applied with edges tightly butted and sealed with a 76 mm (3") wide strip of the vapour barrier material, applied with a compatible adhesive.
13. The insulation shall be impaled on stick clips or pins welded to the duct, and secured with speed washers. Maximum spacing of pins shall be 20 pins per sq. yd.
14. Penetrations of the vapour barrier shall be patched with a strip of vapour barrier material.
15. Duct insulation and vapour barrier, where applicable, shall be continuous through walls and floor openings, except at fire dampers or fire doors. Duct coverings shall also be interrupted at duct access doors, electrical resistance heaters and fuel burning heaters.
16. Where more than one thickness of insulation is required, stagger both longitudinal and horizontal joints.
17. Where voids or openings occur between insulation and duct sleeves void shall be filled.

## Section 23 07 16 HVAC Equipment Insulation

1. Insulate all equipment that operates at less than 15 °C (60°F) and more than 40°C (104°F)
2. Equipment Insulation (above ambient temperature)
3. Insulate domestic hot water tanks, heat exchangers, condensate tanks, flash tanks, and air separators with 51 mm (2") thick sectional semi-rigid mineral fibre, 72 kg/m<sup>3</sup> (4.5 lbs./cu. Ft). See also Division 21
4. Insulation for curved surfaces shall be 51 mm (2") flexible mineral fiber blanket to CAN/CGSB 51.11, or 51 mm (2") thick sectional semi-rigid, as noted above.
5. Hydrous calcium silicate or high temperature mineral fibre (51 mm (2") thick) shall be used on applications where temperatures are greater than 454 deg. C (850 deg. F), i.e.: breeching, diesel exhaust, etc. (to CAN/CGSB -51.2 (CAN/CGSB-51.2-95))
6. Hydrous calcium silicate insulation shall be 51 mm (2") thick, have a density of 208 kg/m<sup>3</sup> (13 lbs./cu.ft.), and a maximum linear shrinkage of 2.2% after a 24-hour period at 649 deg. C (1200 deg). F.
7. Equipment Insulation (below ambient temperature)
8. Insulate chilled water system components and other similar pieces of equipment with 51 mm (2") thick sectional semi-rigid mineral fibre, 72 kg/m<sup>3</sup> (4.5 lbs./cu. Ft), complete with vapour barrier jacket. See also Division 23.
9. Insulation for curved surfaces shall be 51 mm (2") flexible mineral fiber blanket to CAN/CGSB 51.11. (CAN/CGSB-51.11-92), or 51 mm (2") thick sectional semi-rigid, as noted above, complete with vapour barrier jacket.
10. On flat surfaces, mineral fibre insulation shall be applied by impaling the insulation on 9 ga. pins, spot welded, on maximum 30 cm (12") centers, and placed no closer than 102mm (4") from the edge of the board. Secure with 12mm (½") O.D. speed washers. Provide appropriate finish and canvas jacket.
11. On curved surfaces secure the mineral fibre insulation where indicated with galvanized steel wire or aluminum straps. Finish the insulation by applying 25mm (1") galvanized hexagonal mesh and 15 gauge galvanized annealed wire, with metal corner beads applied after the blocks are wired in place. Wire mesh shall be tightly stretched in place and secured with galvanized wire. Overlap mesh points and bind with galvanized wire. Apply one coat, not less than 6mm (¼") thick of hydraulic setting cement and trowel to a smooth finish. Cover with canvas neatly fitted and secured with lagging adhesive. Lap seams at least 51mm (2").
12. Calcium silicate insulation blocks shall be carefully fitted and applied with all blocks staggered. The blocks shall be secured with galvanized wire or aluminum straps.

13. Finish all exposed insulation with canvas jacket that is ULC listed, fire retardant treated, applied with an approved lagging adhesive and painted with a fire-retardant paint with a flame spread rating not greater than 25 and smoke generation rating not greater than 50.
14. Diesel exhaust jacket shall be aluminum.

## Section 23 10 00 Facility Fuel Systems

1. #2 Fuel Oil.
  - 1.1. Fuel Oil Tank Systems Reference Standards
    - 1.1.1. Supply and installation of dual wall oil storage tanks and accessories shall be in accordance with the following standards:
      - 1.1.1.1. Most recent editions of CSA B139 (CSA B139 SERIES:19), CSA B139S1 (standard not found), ULC S601 (CAN/ULC S601-14), CAN4- S602 (CAN/ULC S602-14).
      - 1.1.1.2. Nova Scotia Department of Environment (DOE) - Petroleum Storage Regulations and Construction Standards for Installation and Removal of Petroleum Storage Systems.
    - 1.2. Installation Requirements
      - 1.2.1. Fuel oil storage tank shall be installed by a certified tank installer (Class I License). Tank shall be registered as per DOE Petroleum Storage Tank Regulations. Copy of registration shall be forwarded to DPW.
    - 1.3. Piping
      - 1.3.1. Installed and protected as per CAN 4-S603.1M (CAN/ULC S603.1), latest edition, Appendix B.
      - 1.3.2. Above Grade.
        - 1.3.2.1. Above grade oil lines shall be Schedule 40 black steel pipe, ASTM A53 (ASTM A53/A53M-18) with socket weld fittings or Type L hard copper with silfos joints. Provide fusible link shut-off valve on suction lines at burner. Provide normally closed solenoid valves on each supply line to the boilers where applicable. Provide check valves on return lines only. Return oil lines to be terminated at top of tank. Do not pipe to bottom of tank. Provide ball valve shutoffs on suction lines upstream of fusible links and filters.
        - 1.3.2.2. Above grade black steel pipe located outdoors shall be primed and painted with corrosion resistant coatings. The final connection to the burner shall be with flexible braided stainless-steel hose.
      - 1.3.3. Provide individual suction lines from the bottom of the tank(s) to each boiler. Provide normally closed solenoid valves on each line.

- 1.3.4. A separate pump set and dedicated circulation loop for the boilers may be provided in lieu of individual suction lines and normally closed solenoid valves.
- 1.3.5. Below Grade
  - 1.3.5.1. Buried pipe shall be double wall, continuous polyethylene piping consisting of a ULC listed flexible inner primary pipe encased within a ULC listed flexible outer containment pipe.
- 1.4. Accessories
  - 1.4.1. Vent shall be fitted with a screened elbow and Vent-A-Larm.
  - 1.4.2. Fuel oil filter shall be heavy duty type, simplex filters at pump suction.
  - 1.4.3. Float activated fill limiting valve (overflow preventer valve) to be installed in the tank to back flow up the fill pipe when the tank is 95% full. Provide necessary coupler/adaptor for fuel delivery.
  - 1.4.4. Provide a distant reading fuel gauge (Levelometer) with installation in the Boiler Room.
- 1.5. Tanks
  - 1.5.1. General
    - 1.5.1.1. Provide a CSA certified above ground exterior oil tank. Size tank for minimum one week oil storage capacity at design winter temperature.
    - 1.5.1.2. Dual wall construction, with tank saddles continuous welded to tank shell.
    - 1.5.1.3. Tank to be coated, at factory, with one coat of corothane zinc primer and two coats of white corothane II moisture cured urethane finish (or two coats of heavy-duty marine type paint which requires approval in writing from DPW). Provide one pint of touch- up paint.
    - 1.5.1.4. Fill service platform shall be 91cm (36") x 61cm (24") with stairs (ships ladder not acceptable). Platform/stairs to be 100% galvanized including railings and be complete with non- slip treads.
    - 1.5.1.5. All hinges, bolts and bung fittings to be galvanized or stainless steel.
    - 1.5.1.6. Tank to have a 25-litre lockable spill containment box. Locate vacuum monitor gauge in box. Fill box shall be pre-drilled, at high level, for tank monitor conduit, at factory.

1.5.2. Concrete Work

1.5.2.1. Concrete tank pad (above/below grade) shall be minimum 12" thick, length and width extending 18" beyond tank dimensions.

1.5.2.2. Pad shall be structurally reinforced.

1.5.2.3. Concrete to be a minimum 4000 lb. test.

1.5.3. Fencing

1.5.3.1. Provide chain-link fencing (minimum height 244cm (8'-0")) around the tank c/w lockable access gate. Also provide concrete filled metal bollards to protect tank from vehicles.

2. Propane / Natural Gas System

3. Provide a complete propane distribution system including connection to exterior propane tank(s). Coordinate tank installation (size of tank(s), location etc.) with DPW/building operator and their propane service contractor.

4. System shall be in accordance with applicable codes and authorities having jurisdiction. Installation shall be carried out by a licensed propane installer.

5. Above grade pipe shall be Schedule 40 black steel with socket welded joints or Type K copper with silfos joints. As noted elsewhere, under the subject of Pipe Identification, paint the entire propane or natural gas piping system yellow and ensure proper stenciled identification is used.

6. Pipe supports and hangers shall be as per authorities having jurisdiction or the DC350, whichever is more stringent. Pipes running outside on roofs to be mechanically fastened to the roof structure (e.g. Thaler anchors). Supporting the pipe on wood sleepers placed on top of the roof is not permitted.

7. Provide a reinforced cast-in-place structural concrete slab base for the tank(s) and chain-link fencing (minimum height 8'-0") around the tank(s) c/w lockable access gate. Also provide concrete filled metal bollards to protect tank(s) from vehicles.

8. Gas outlets shall be provided with pins, lugs etc. secured to the mounting benches to prevent tampering with the system and release of propane gas.

## Section 23 20 00 HVAC Piping and Pumps

### 1. Pipe and Fittings

1.1. Hot water heating, chilled water, condenser water, glycol, diesel cooling, diesel exhaust and steam piping (excluding steam piping in boiler plant and steam vent piping) shall be as follows.

#### 1.1.1. Pipe

1.1.1.1. 51mm (2") and Smaller: BW steel, Sch. 40 ASTM A53 (ASTM A53/A53M-18), Grade B.

1.1.1.2. 64mm (2½") and Larger: ERW steel, Sch. 40, ASTM A53 (ASTM A53/A53M-18), Grade B.

1.1.1.3. Copper Tube: Type L hard drawn.

#### 1.1.2. Joints:

1.1.2.1. 51mm (2") and Smaller: Screwed

1.1.2.2. 64mm (2½") and Larger: Welded, Flanged

1.1.2.3. Copper Joints: Solder, lead free.

1.1.2.4. Roll grooved joints are also acceptable for hot water heating, chilled water, glycol, condenser water and diesel radiator piping.

1.1.2.4.1. Roll grooved coupling, complete with EPDM gaskets at elbows only.

1.1.2.4.2. Roll grooved coupling, complete with EPDM gaskets at straight run of pipe.

#### 1.1.3. Fittings

1.1.3.1. 51mm (2") and Smaller: Standard Malleable Iron, Banded Threaded, 57kg (125 lb.) class.

1.1.3.2. 64mm (2½") and Larger: Sch. 40 Steel Butt Welded ASTM A234 (ASTM A234/A234M-18a), Grade A, Weld-0-Lets or equal.

1.1.3.3. Copper Fittings: Wrought copper.

1.1.3.4. Roll grooved fittings and tees.

1.1.3.5. Unions: 51mm (2") and Smaller: Class 150 malleable iron, brass to iron seats.

1.1.3.6. Flanges

- 1.1.3.6.1. All: Class 150 steel slip-on or weld neck type, raised face, ASTM A181 (ASTM A181/A181M-14).
  - 1.1.3.6.2. Bolts: Stud bolts, carbon steel, heavy hex nuts.
  - 1.1.3.6.3. Gaskets: All – 1.6mm (1/16") thick Cranite or approved equal.
- 1.2. Headers shall consist of the required length and size of pipe with each take-off welded into the pipe. Roll groved couplings also permitted for take-offs. Ends of all headers shall be finished with welding caps or groved couplings.
  - 1.3. Branch connections shall be made using pipe cut into the main and/or weld-o-lets where the main is twice the diameter of the branch, otherwise welding tees shall be used. Alternatively, use an approved hole cut mechanical tee piping system.
  - 1.4. If roll groove piping system is used, all couplings and fittings shall be of the same manufacturer.
  - 1.5. Piping Installation
    - 1.5.1. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible. Form right angles or parallel lines to building walls.
    - 1.5.2. Locate groups of pipe parallel to each other spaced at a distance to permit applying full insulation and access for servicing valves.
    - 1.5.3. Grade forced water piping 25mm (1") per 1829cm (60'-0") so that when the system is filled, the air in the mains and risers shall be carried to venting high points and drains at low points.
    - 1.5.4. Forced water return and supply piping shall be taken off main at 45° angle vertically from each main or branch main. Runouts shall be made with four (4) joints to permit expansion and avoid strain on equipment.
    - 1.5.5. Provide air vents at all high points in the piping system. Air vents shall be installed at an accessible place in order to facilitate maintenance.
    - 1.5.6. Valved by-passes shall be provided for equipment requiring disconnection for repair or replacement, including, but not limited to 3-way valves, water make-ups, PRVs, steam traps, steam and condensate meters.
    - 1.5.7. Unions shall be provided in the by-passes and shall be located between the shut-off and the equipment. Do not conceal unions in walls, partitions or ceilings.



- 1.5.8. Provide shut-off valves in risers and main branches at point of takeoff from the supply or return main, individual equipment units at inlets and outlets to permit removal for repairs without interfering with remainder of the system, and in equipment by-passes.
- 1.5.9. Keep piping free from scale and dirt. Protect open pipe and whenever work is suspended during construction, to prevent foreign bodies entering or lodging, using temporary plugs, burlap or other approved materials for protection.
- 1.5.10. Expansion Loops and Anchors
  - 1.5.10.1. Control the direction and extent of pipe movement in mains and risers by the use of loops, bends, offsets, guides and anchors. Compensators will also be considered where space does not permit loops or bends (obtain specific written permission from DPW).
  - 1.5.10.2. All expansion loops or bends shall be half cold spring, and/or branch connections shall have strain, on when cold, off when hot.
  - 1.5.10.3. Anchors shall be fabricated from angle iron sections and fastened to the building structure.
  - 1.5.10.4. Provide roll groved couplings on expansion loops where roll groove joints are used.
- 1.5.11. All elbows shall be long radius.
2. Valves
3. Each valve type to be of one manufacturer and shall have the manufacturer's name and pressure rating clearly marked on the outside of the body.
4. The metals used in the bodies, bonnets, yokes, and discs of all the bronze valves shall conform to ASTM B62. In iron body valves, the cast iron shall conform to ASTM A126 (ASTM A126-04(2014)) Class B.
5. Composition discs on all valves shall be suitable for the service and shall be as recommended by the manufacturer.
6. Use globe valves for by-passes that are the same size as control valves and pressure reducing stations. Use ball valves for pipe 51mm (2") and smaller.
7. Balancing Valves
8. Provide circuit balancing valves on returns from force flow heaters, unit heaters, heating coils and wall mounted radiators. Also provide circuit balancing valves on main and branch supplies/returns for easy balancing of the system and on each boiler return to ensure even flow. Triple duty valves (with memory stop) may be used in lieu of gate valve, balancing valve and check valve, at pump discharges.

9. Provide a memory stop balancing valve in conjunction with a flow measuring fitting on in-floor heating manifold returns and radiant ceiling panel manifold returns. Circuit balancing valves (circuit setters) are also acceptable.
10. Locate valves for easy access. Do not locate stems below horizontal.
11. Balancing shall be sized according to flow and NOT line size only.

## Section 23 21 00 Hydronic Piping and Pumps

### 1. Hydronic Specialities

#### 1.1. Air Vents

- 1.1.1. At every high point in piping system, provide automatic air eliminators in order to avoid air pockets in the system. Air vents shall be installed at an accessible place with the aid of necessary piping in order to facilitate maintenance.
- 1.1.2. Provide manual air vents at high points of the system and return bends to permit draining.
- 1.1.3. Use automatic float type vents at difficult to get at points only and provide drip point. A collecting standpipe is recommended at any high point which might cause air binding.
- 1.1.4. Provide a mini ball valve for shut-off and servicing of the vent.
- 1.1.5. Provide automatic type air vents on all upfeed radiation.
- 1.1.6. For shell and tube steam convertors, provide automatic air purging.
- 1.1.7. All air vents where possible are to be complete with collecting chambers.
- 1.1.8. Arrange the piping so that the air purging will follow the direction of water flow in branches and risers.

#### 1.2. Drains/Sediment Faucets

- 1.2.1. Provide sediment faucets at the low points of piping and on radiation.
- 1.2.2. On mains, risers and equipment provide drain valves. Drain valves shall be minimum 2068 kPa (300psi) water rated, 19mm (3/4") diameter straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 19mm (3/4") diameter garden hose, and a cap and chain. Drain valve to be lead free.
- 1.2.3. All small drains from each piece of equipment shall be brought over to a funnel floor drain and shall terminate 51mm (2") above the funnel. These shall include small surface drains from boilers, heating system main drain outlets, etc. and shall be run in steel piping to nearest floor drain or hopper. No drain or over flow line shall be left so that liquid or vapour will spill on equipment or floors. Cut drain pipes at 45° angle to drain top.

- 1.3. Air Separator / Purger
  - 1.3.1. Working pressure 862 kpa (125 psi).
  - 1.3.2. Provide centrifugal type with galvanized steel 5 mm perforated strainer, perforated stainless steel air collector tube and drain connection. Provide on suction side of system circulation pump and connect to expansion tank.
- 1.4. Safety and Relief Valves
  - 1.4.1. Provide ASME rated direct spring-loaded type, lever operated non-adjustable factory set discharge pressure as indicated. Provide relief valves on pressure tanks, low pressure side of reducing valves, heating convertors and where indicated. Drain relief valve discharge to nearest floor drain. System relief valve capacity shall equal make-up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment. Where one line vents several relief valves, cross sectional area shall equal the sum of individual vent areas and must be vented to prevent the discharge going back to one of the other relief valves.
  - 1.4.2. Locate and install so that they can be taken apart without breaking piping connections.
  - 1.4.3. Provide safety valves at all heat exchangers and as otherwise required.
  - 1.4.4. Provide relief valves in piping between isolation valves and heat exchangers.
- 1.5. Strainers
  - 1.5.1. "Y" pattern, full size of pipe.
  - 1.5.2. 2" and smaller shall be threaded; 64mm (2½") and larger shall be flanged.
  - 1.5.3. Strainers shall have stainless steel or monel perforated screens. Install strainers at the inlet of all pumps, reducing valves, flow regulators, etc.
  - 1.5.4. Install strainers in vertical lines with downward flow or in horizontal lines. Do not install in vertical lines with upward flow.
- 1.6. Expansion Tank
  - 1.6.1. Provide diaphragm type for acceptance volume up to 132 litres (35 US gallons), and bladder type for acceptance volume over 132 litres (35 US gallons).

- 1.6.2. Pre-charged expansion tank shall be complete with air control fitting and water make-up accessories, from the same manufacturer.
- 1.6.3. The tank system connection shall be at or near the pump suction.
- 1.6.4. Use 19mm (3/4") minimum pipe size for tank connection to system. Minimize length of horizontal piping.
- 1.6.5. Provide lockshield isolation valves at expansion tanks.
- 1.7. Water Make-up System
  - 1.7.1. Water make-up connection must have an approved and certified backflow device.
  - 1.7.2. Provide pressure gauge complete with mini ball valve, on both sides of the make-up assembly. Also provide valved bypass piping around make-up assembly.
  - 1.7.3. Locate water make-up feed connection at the point of no pressure change.
2. System Pressurization
3. The fill pressure at the system pump intake shall be the saturation pressure of water -9 deg. C (15 deg. F) above the system design operating temperature.
4. This minimum pressure shall ensure at least 27 kpa (4 psig) at the top of the system.
5. Locate the boilers and a system relief valve on the suction side of the pump.
6. Standard pressure settings of 241 kpa (35 psig) for relief valve and 83kpa (12 psig) for automatic fill valve are suitable for water temperatures up to 110 deg. C (230 deg. F) and static heads up to 549cm (18 feet).

## Section 23 22 00 Steam and Condensate Piping and Pumps

1. Steam piping between boilers and main header, condensate, boiler blowdown, and boiler feed piping.
  - 1.1. Pipe: Extra strong black steel, Sch. 80, ERW or seamless ASTM A53 (ASTM A53/A53M-18), Grade B.
  - 1.2. Joints: Screwed or welded up to 51mm (2"), welded 64mm (2½") and larger.
  - 1.3. Fittings: 51mm (2") and smaller, 2068 kpa (300) psi malleable iron banded screwed; 64mm (2½") and larger, 2068 kpa (300) psi steel butt welded.
  - 1.4. Unions: 2068 kpa (300) psi malleable iron, ground joint.
  - 1.5. Flanges: 2068 kpa (300) psi steel slip-on type ASTM A181 (ASTM A181/A181M-14), Grade 1 with 1.6 mm (1/16") Cranite gaskets. (or Lamons Flexatalic, SS 316)
2. Untreated steam and condensate piping for humidification (for steam to steam type systems)
3. Pipe: Schedule 40 stainless steel to ASTM A213 (ASTM A213/A213M-18b) Grade 316.
4. Joints: Socket weld to schedule 40 pipe size. Grade 316 stainless steel.
5. Fittings: Socket weld to schedule 40 pipe size. Grade 316 stainless steel.
6. Unions: 1034 kpa (150 psi) stainless steel, ground joint. Grade 316.
7. Flanges: 1034 kpa (150 psi) stainless steel, slip-on type with 1.6mm (1/16") Teflon gaskets. Grade 316. (or Lamons Flexatalic, SS 316).
8. Steam Traps
9. Provide individual traps for heating units.
10. Provide a sediment strainer at each trap.
11. Thermostatic traps shall be provided for units with slowly varying, low volume loads (i.e., convection-radiation type heating units) and for drip points of branch risers to each unit. A pipe cooling leg is recommended before the drip trap.
12. Float and thermostatic traps are recommended for heating units with steam pressures up to 345 kpa (50 psig), with varying pressures and loads (modulating type operation), (i.e., heaters, air heating coils, and liquid coil heaters). Use at drip points.
13. Bucket traps are recommended for steam pressures above 345 kpa (50 psig) and heavy intermittent loads. Inverted type is self cleaning.
14. Where steam binding or locking conditions can occur, use a specialty trap.

15. Except for thermostatic traps at convectors, locate traps as close to the heater outlet as possible.
16. Prevent water hammer at all water collection points.
17. Protect traps against freezing.
18. Flash Steam
19. Recover such heat by means of flash tank. Use the flash steam as a heat source for low pressure systems. If this is not possible, use the available flash steam and high temperature condensate for feed water or domestic water heating through a shell and tube economizer.
20. Provide Steam Pressure Reducing Stations
21. Complete with pressure reducing valve(s), valved bypass, strainer and pressure gauge on upstream side, relief valve and pressure gauge on downstream side.
22. Pressure Reducing Valves
23. Use single-seated valves for dead-end and tight shut-off. Use pilot controlled or air-loaded direct-operated valves where variable inlet pressures occur and when close control of the reduced pressure is necessary. Where light loads and cycling control, use two reducing valves in parallel and size valves for 70 and 30 percent of maximum flow. Two-stage reduction is recommended for pressure reductions over 689 kpa (100 psig).
24. Pressure reducing valve(s) shall have diaphragm, bronze body, balanced design, stainless steel trim and pilot operator.
25. Steam Air Vents
26. Provide automatic steam air vents of the thermostatic balanced pressure type, with brass or semi-steel body, renewable stainless-steel head and seat. Fabricate thermostatic liquid filled bellows of phosphor bronze.

## Section 23 23 00 Refrigerant Piping

1. Tubing
  - 1.1. Tubing shall be processed for refrigeration installations, factory cleaned, deoxidized, dehydrated, and sealed seamless refrigeration copper tubing.
  - 1.2. Hard copper tubing shall be type ACR B to ASTM B280 (ASTM B280-18).
  - 1.3. Annealed copper to ASTM B280 (ASTM B280-18) for a maximum of the last 61cm (2') of piping at refrigerant equipment.
2. Fittings
3. Design pressure 2068 kpa (300 psi) and 121 deg. C (250 deg. F) .
4. Brazed wrought copper, joint shall be silver solder.
5. Long radius type for elbows and return bends.
6. Sleeves
7. Hard copper sleeve sized to provide 6mm (¼") clearance around and between sleeves and uninsulated pipe or between sleeve and insulation.
8. Insulation
9. Exterior insulation shall be wrapped in aluminum alloy jacketing.
10. Installation
11. Bleed inert gas into pipe during brazing.
12. Purge refrigerant lines and piping.
13. When multiple lines are run, spread pipes 152mm (6") minimum to allow for expansion and contraction.
14. Install straight, parallel and close to walls and ceilings, with specified pitch.
15. Piping to be installed to prevent condensate or oil from flowing back into compressor or evaporator.
16. Bleed dry nitrogen into piping when sweating connections.
17. Enclose tubing exposed to mechanical injury in rigid or flexible conduit.
18. Soft annealed tubing: bend without crimping or constriction.
19. Hard drawn copper tubing: do not bend and minimize use of fittings.
20. Hot Gas Lines: Provide trap at base of risers greater than 244cm (8') high and at each 762cm (25') thereafter. Provide deep trap at top of risers.
21. Testing



22. Pressure and leak testing shall be performed.
23. Provide 4 days' notice to Consultant and DPW before charging.
24. Consultant and DPW have the right to request Contractor to cut out 2 fittings per 25 to allow for inspection of purity of joints

## Section 23 25 00 HVAC Water Treatment

1. Feedwater Equipment
  - 1.1. Pre-Charged Expansion Tanks
    - 1.1.1. Tanks to be suitable for 689kpa (100psi) working pressure.
    - 1.1.2. Tank shall be precharged as required to suit system requirements.
    - 1.1.3. Drains shall discharge to a floor drain.
    - 1.1.4. Tanks shall be complete with suitable supports.
    - 1.1.5. Tank shall be complete with automatic fill.
    - 1.1.6. Provide lockshield isolation valve on supply.
    - 1.1.7. All expansion tanks shall be supported with suitable hangers or pipe stands as required according to the size of the tank.
  - 1.2. Automatic Water Feeder:
    - 1.2.1. Pipe relief valve to floor drain.
    - 1.2.2. To be complete with reduced pressure type back flow preventer.
    - 1.2.3. Domestic water shall not be directly connected to piping systems containing glycol.
2. Chemical Treatment
3. System water shall be slightly alkaline at all times, between 7.0 and 9.0 pH. Chemical additives shall not adversely affect any components of the system (i.e., mechanical pump seals, valve glands, etc.).
4. Chemical treatment shall be provided for the water, steam and condensate, boilers, chilled and condenser water and glycol heating systems (not required in glycol systems if inhibitors already present in glycol).
5. Provide chemical pot feeder piped in system with extra strong Schedule 80 black steel pipe and crosses provided in lieu of 90° turn with unused opening plugged. Fittings also to be extra strong 2068kpa (300psi).
6. Provide chemical boil-out of boilers using chemicals recommended by the chemical treatment manufacturer. Isolate auto-air vents during initial treatment. Pre-operational cleaner shall be used to clean all closed chilled water, hot water and glycol piping systems.
7. After pressure tests are completed and approved, prior to start-up and placing into operation, flush and clean out all piping systems before adding any chemical treatment.

8. Provide a 40% propylene glycol, pre-mixed solution complete with inhibitors for the glycol heating system.
9. Provide corrosion inhibitors for all piping systems and supervise cleaning operation.
10. Chemical treatment supplier shall supervise the treatments and boil-out of all systems and provide test reports before systems are made operational. Approval in writing of the test results is required from the mechanical design engineer before the system is considered acceptable.
11. Factory trained representatives from the chemical treatment supplier shall provide on-site instruction (minimum one hour) in operation and maintenance procedures for the to the building operators.

## Section 23 30 00 HVAC Air Distribution

### 1. HVAC Ducts and Casing

- 1.1. Galvanized sheet metal ductwork shall be specified for supply, return and washroom exhaust air systems. All ductwork shall consist of sheet metal manufactured, shipped and fabricated using oil-free methods.
- 1.2. Classification shall be in accordance with SMACNA (fan static pressure shall determine classification).
- 1.3. Construction
  - 1.3.1. Ductwork shall be to ASHRAE and SMACNA. (see below for additional requirements) Ductwork shall be galvanized steel, lock forming quality to ASTM A525M (ASTM A525M: 1991), Z90 zinc coating.
  - 1.3.2. Clean ductwork, plenums and equipment prior to start-up.
  - 1.3.3. Longitudinal seams shall be to SMACNA Standard Fig. 105 Types L-1 to L-5.
  - 1.3.4. Duct Joints
  - 1.3.5. Joints shall be to ASHRAE and SMACNA.
  - 1.3.6. Manufactured joint systems (Ductmate and Nexus) are also acceptable.
  - 1.3.7. Ductwork at all intakes, exhausts and other places where moisture may occur shall be watertight. At these places ductwork shall be sloped towards a low point where a minimum 32mm (1¼") drain with deep seal trap shall be provided, discharging to a funnel floor drain. Air handling unit intake and exhaust plenums shall each be provided with a minimum of two such drains with trap depth a minimum 150% of the unit maximum static pressure. Provide an electronic primer on each trap. Dishwasher exhaust ductwork shall also be watertight.
  - 1.3.8. Ductwork shall be free from pulsation or objectionable noises.
  - 1.3.9. Install duct elbows having a throat radius 1½ times the diameter, or fabricate with square throats and backs fitted with duct turns. Duct turns shall be fabricated with double width blades of approved construction.
  - 1.3.10. All vertical ducts in shafts shall be rigidly supported with steel angle. In no case shall angles be less than 38mm x 38mm x 6mm (1½" x 1½" x ¼").

- 1.3.11. Where ducts pass through walls or floors, coordinate with architectural/structural disciplines to ensure integrity of the construction. At fire dampers and where ducts pass through floors, provide a continuous galvanized steel angle iron frame minimum size 38mm x 38mm x 6mm (1½" x 1½" x ¼") (or as per fire damper manufacturer requirements) which shall be bolted to the construction and made air-tight to the same by applying appropriate caulking compound. Sheet metal at these locations shall be bolted to the angle iron.
- 1.3.12. During construction, seal all openings with polyethylene and tape at all times to prevent entrance of dirt, dust, etc.
- 1.3.13. Round Ducts
- 1.3.13.1. Concealed round branch ducts up to 36cm (14") diameter may be constructed with longitudinal or spiral lock seams.
- 1.3.13.2. Concealed round branch ducts 38cm (15") and over and all exposed round ducts shall be factory fabricated conduit consisting of helically wound galvanized iron strips with spiral lock seams. Fittings for these conduits shall be fabricated of 20 gauge galvanized sheet steel of gauges per SMACNA with butt welded seams of standard dimensions.
- 1.3.13.3. Long radius elbows shall be used where space permits. Where 90 deg. take-offs are necessary, conical "Ts" shall be used.
- 1.3.13.4. Conical tee fittings shall follow SMACNA Fig. 3-4 90 deg. Tee with Oval to Round Tap.
- 1.3.13.5. Round ducts and fittings shall be galvanized steel of the following minimum gauges:

Duct Diameter	Spiral Duct Gauge	Plain Duct Gauge
20-0cm (8"-0")	28	24
23-36cm (9"-14")	26	24
38-66cm (15"-26")	24	N/A
69-91cm (27"-36")	22	N/A
94-127cm (37"-50")	20	N/A

1.3.14. Finish

- 1.3.14.1. Where ducts run exposed outside of mechanical rooms provide a satin coat finish which is to be followed by suitable painting.

1.3.15. Duct Sealing

- 1.3.15.1. Sealing shall be in accordance with SMACNA pressure classifications.

- 1.3.15.2. All duct joints and connections shall be made airtight with duct sealant, tape or a combination thereof (method depends on the classification), applied according to the manufacturer's recommendations as the ducts are being constructed.

1.3.15.3. Duct sealant shall be:

- 1.3.15.3.1. Water and oil resistant

- 1.3.15.3.2. Compatible with duct materials.

- 1.3.15.3.3. Rated at 25 or less for flame spread and 50 or less for smoke developed.

- 1.3.15.3.4. Nontoxic, low VOC emission.

1.3.15.4. Duct tape shall be:

- 1.3.15.4.1. Polyvinyl treated, open weave fibreglass, 51mm (2") wide.

1.3.15.5. Method

- 1.3.15.5.1. Surfaces shall be cleaned and treated in accordance with manufacturer's recommendations.

- 1.3.15.5.2. Apply sealant in accordance with SMACNA and manufacturer's recommendations.

- 1.3.15.5.3. Where tape is required by the classification, bed tape in sealant (overlapping the area to be sealed by 51mm (2")) and recoat with minimum of 1 (one) coat of sealant to the manufacturer's recommendations and closing all openings in the weave.

1.4. Special Duct Materials

- 1.4.1. Ductwork for kitchen exhaust shall be welded construction minimum 18-gauge type 30 stainless steel, complete with cleanouts, to the requirements of NFPA 96 (NFPA (Fire) 96: 2017), latest

- edition. Welded black steel (minimum 16 gauge) is permitted where the kitchen exhaust duct is concealed in ceilings, walls or shafts.
- 1.4.2. Laboratory exhaust ductwork (serving chemical fume hoods and chemical storage cabinets) shall be minimum 18 gauge type 316 stainless steel with welded joints.
  - 1.4.3. Dishwasher exhaust ductwork shall be aluminum, sloped to a low point with a drain and deep seal trap.
- 1.5. Flexible Ductwork
- 1.5.1. Flexible ductwork shall be used for acoustical purposes at supply air terminal units. The minimum length shall be 91cm (3'), maximum length shall be 152cm (5'), with at least one support required. Note: Flexible ductwork is not permitted on the return or exhaust side.
  - 1.5.2. There is to be no more than a 15-degree change in direction in flexible ductwork. For changes in direction of more than 15 degrees, use rigid ductwork for the change (i.e. provide sheet metal elbows at air terminals).
  - 1.5.3. Flexible ducts shall be:
    - 1.5.3.1. UL listed for Class I air duct material, UL-181 (UL 181: 2013).
    - 1.5.3.2. In accordance with NFPA Standard 90A (NFPA (Fire) 90A: 2017).
    - 1.5.3.3. Constructed of a non-collapsible, corrosion resistant, spring steel helix bonded to a vinyl inner liner and covered with a factory applied, wrapped, glass fiber acoustic insulation and vapour barrier jacket.
    - 1.5.3.4. Capable of operating at pressure from 10" positive to 1" negative.
    - 1.5.3.5. Capable of operating at temperatures from -18 deg. C (0 deg. F) to 93 deg. C (200 deg. F).
    - 1.5.3.6. Install flexible ductwork fully extended and use only foil tape, not grey fabric tape, to seal ends of flexible ductwork.
- 1.6. Storage of Ductwork
- 1.6.1. All ductwork shall be stored indoors, on pallets and tightly wrapped/covered in poly. Storing ductwork outdoors under tarps is not permitted.
- 1.7. Duct Cleaning prior to Installation
- 1.8. Clean inside surfaces of ductwork, during/prior to installation, to remove oil, debris and dust. Use non-toxic cleaners to remove oil.

## Section 23 33 00 Air Duct Accessories

1. Relief Dampers
  - 1.1. Avoid use of unregulated relief dampers.
  - 1.2. Where unregulated relief damper must be used, apply heavy duty type which will not flutter or chatter under normal wind velocity or fan discharge conditions.
2. Volume Dampers
3. At each supply, return and exhaust air branch take-off and in such other locations to allow proper and easy balancing of the air distribution systems, furnish and install as close as possible to the take-off, volume dampers with damper regulators.
4. Provide single blade dampers in branch take-offs for volumes up to 28 m<sup>3</sup>/min (1000 cfm) and multiple opposed blade dampers for volumes over 28 m<sup>3</sup>/min (1000 cfm).
5. All volume dampers to be supported at both ends.
6. Turning Vanes
7. To be used to improve air flow through changes in direction of ductwork, when large radius turns or two 45 degrees elbows cannot be used because of space considerations.
8. Factory or shop fabricated single thickness without trailing edge, to recommendation of SMACNA.
9. Access Doors
10. Provide adequately sized galvanized steel access doors for all devices requiring inspection, maintenance or cleaning.
11. Access doors shall be located before and after coils, filters, fans, automatic dampers, at fire dampers, fresh air and exhaust air plenums, bottoms of risers, and where required elsewhere.
12. Access doors shall be minimum 30cm x 30cm (12" x 12") for hand access and 61cm x 61cm (24" x 24") for body access.
13. Access doors shall be tight fitting with Allen key Camlock. Screw-slot locking devices are not allowed. Insulate access doors where they are installed in insulated ductwork or plenums.
14. Access doors in ductwork shall be no more than 914cm (30') apart for duct cleaning purposes.
15. Gasketed panels (patches) minimum size 30cm x 30cm (12" x 12") and fabricated from the same material as the duct and fastened with sheet metal screws are



permitted if the access is for cleaning only; otherwise access doors shall be provided.

16. Fire Resistance
17. Fire-resistive ceilings may be provided with duct openings complying with UL testing.
18. Provide fire dampers at all fire separation penetrations.
19. Fire Dampers
20. Fire dampers shall be ULC approved and labeled, and lock in a closed position when released by approved fusible links.
21. Shop fabricated fire dampers shall not be accepted, the dampers shall be a manufactured item.
22. Each damper shall be provided with a suitably located access panel with removable covers to allow resetting of dampers.
23. Fire dampers shall be located within the fire separation.
24. Provide galvanized steel angle frames, sized as per manufacturer's recommendation, on the outer perimeter of all fire damper installations, on both sides of the penetration.
25. Fire dampers shall be complete with corrosion resistant springs, bearings, bushings and hinges.
26. Flexible Connections
27. Flexible connection shall be:
28. Heavy glass fabric, double coated with neoprene.
29. Non-combustible.
30. Weatherproof and airtight.
31. Resistant to acids, grease, alkaline, oil and gasoline.
32. Acceptable for temperatures up to 93. Deg C (200 deg. F).
33. Flexible connections shall be pre-assembled of 24-gauge galvanized metal clinched by means of a double lock seam to each side of the fabric.
34. Flexible connections shall be installed on the inlet and outlet connections of each fan and A/H unit (although not required on A/H unit if internally isolated).
35. Flexible connections shall be a minimum of 152mm (6") long and installed with adequate slack (a minimum of 76mm (3")) of fabric between the metal ends whether the equipment is on or off) and a ground strap.
36. Sound Attenuators /Duct Silencers

37. Outer casings of silencers shall be fabricated from not less than 22-gauge galvanized steel in accordance with the ASHRAE Guide or SMACNA recommended construction for ductwork. Seams to be lock-formed and mastic-filled. Interior casings for silencers shall be fabricated from not less than 26 gauge galvanized perforated steel. Use 10-gauge HTL outer casing to reduce noise transmission in applications where additional sound attenuation is required.
38. Silencers shall not leak air or fail structurally when subjected to a differential air pressure of 20cm (8") water gauge inside to outside of casing.
39. Filler material shall be not less than 16kg/m<sup>3</sup> (1 lb./cu.ft.) inorganic mineral or glass fiber packed under at least 5% compression. Material shall be inert, vermin and moisture proof and further enclosed with a tight woven fabric beneath the perforated liner. Combustion rating of the filler material shall be not less than the following when tested in accordance with ASTM #84 (Standard not found), NFPA Standard 255 (NFPA (Fire) 225: 2017) or UL No. 723 (UL 723: 2018):
  40. Flame Speed Rating = 25
  41. Smoke Development Rating = 50
  42. Fuel Contribution Rating = 50
43. Acoustical test shall conform to ASTM E-477073 (standard not found) standard method of testing duct liner material and manufactured silencers for acoustical and airflow performance. Tests shall be run both with and without air flowing through the silencer at not less than 3 different flow rates. All ratings shall be based on test data from a nationally known qualified independent laboratory. Test methods shall eliminate effects due to end reflection, vibration, flanking transmission and standing waves in the reverberant room. Air flow and pressure loss measurements shall be made in accordance with the applicable portion of ASME, SMACNA and ADC airflow.
44. Acoustic duct liner is not permitted.
45. Provide silencers in all ducts to and from air handling units.

## Section 23 34 00 HVAC Fans

1. General
  - 1.1. Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building or adjacent properties.
  - 1.2. Provide balanced variable sheaves for motors 10 kW and under and fixed sheave to 15 kW and over.
  - 1.3. Fans shall be capable of accommodating static pressure variations of +10% with no objectionable operating characteristics.
  - 1.4. All exhaust air systems shall be complete with birdscreen and low leakage backdraft dampers. Refer to Section 23 09 00 for motorized backdraft damper requirements.
  - 1.5. Provide suitable vibration isolation and flexible connections (refer to other sections of this document).
2. Beltguards
3. Provide for each V-belt drive a perforated galvanized steel belt guard, constructed with a galvanized steel frame and access openings for tachometers.
4. Belt guards shall be securely bolted to floor or apparatus and shall completely enclose drive and pulleys.
5. Fans shall be selected to allow for reduced fan speeds and therefore reduced sound power levels.
6. Centrifugal type with multi-blade wheel statically and dynamically balanced.
7. Install fans on solid or hollow steel shafts as required and mount on self-aligning ball bearings. Provide lubrication fittings within the casing, within reach and sight of bearings. Provide extended lubrication fittings only if there is an unavoidable lack of access to a bearing (e.g. due to a small existing mechanical room on a renovation project).
8. Provide variable sheaves for motors 11 kW and under and fixed sheaves for 15 kW and over.
9. Provide flexible connections at the inlet and outlet of fan section.
10. Fan motors shall be mounted within the casing of all air handling units.
11. Centrifugal Fans
12. Provide multi-blade wheels in heavy gauge steel housing reinforced for service encountered.
13. Provide V-belt drives with fan and motor mounted on reinforced, rigid steel base with adjustable motor mount.

14. Provide heavy duty, self-aligning, anti-friction bearings with external lubrication.
15. All units shall be provided with suitably sized vibration isolators.
16. Units suspended from the structure shall be provided with suitably sized hanger rods. Steel channel sections shall be provided to distribute the weight of the units over an appropriate number of joists where such structural framing occurs.
17. Floor mounted units shall be supported by angle iron stands or pipe stands. Flexible connections shall be provided at the inlet and outlet of each fan.
18. Fans shall be mounted in such manner so that maximum space is available for access to all parts requiring periodic maintenance while maintaining adequate headroom. Co- ordinate with other sections to ensure that maximum access is maintained.
19. Provide access door and drain connection to scroll.
20. In-Line Centrifugal Fans
21. Characteristics as for centrifugal, with axial flow and direct or belt drive.
22. Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth round inlets and stationary guide vanes.
23. Cabinet Fans
24. Centrifugal direct drive fan.
25. Galvanized steel housing.
26. Disconnect within the fan housing.
27. Acoustically lined housing.
28. Packaged Exhausters
29. Wall and roof exhausters shall be complete with disconnect switch.
30. Exhausters shall be direct or belt drive and shall be constructed in such a manner that motors, disconnects, etc. are readily accessible.
31. Each roof exhauster shall be mounted on a wooden curb; ensure that weather tight flashing is provided. Curb height shall be a minimum of 46cm (18") above the top of the finished roof.
32. Heavy aluminum dome type housings shall be reinforced as necessary on sizes with 500 mm wheel and larger.

## Section 23 37 00 Air Outlets and Inlets

1. Grilles, Registers, and Diffusers
  - 1.1. Supply air shall be introduced through ceiling mounted supply diffusers or duct-mounted diffusers located at ceiling height in rooms with no dropped ceiling. Careful attention must be given for supply diffusers and return/exhaust air grilles located in secure areas or subject to impact. In these cases, diffusers and grilles shall be tamper-proof, heavy-duty, and complete with safety chains as appropriate.
  - 1.2. Return and exhaust air shall be removed through ceiling mounted registers.
  - 1.3. Size grilles, registers and diffusers for proper air velocities and low noise levels.
  - 1.4. Air supply to a space shall be distributed to the occupied zone as per ASHRAE and also the grille and diffuser manufacturer's recommendations. Ensure that proper air distribution and occupant comfort are achieved through appropriate air outlet application, quantity, selection and location.
  - 1.5. Select air outlets so that the combined sound from all diffusion in a room meets the design criterion.
  - 1.6. All grilles and diffusers shall be of one manufacturer, where possible.
  - 1.7. All diffusers, grilles and registers shall be free of fluttering, chattering and vibration.
  - 1.8. Install in accordance with manufacturer's instructions.
2. Air Louvres and Screens
3. Apply louvres that minimize entry of snow and water into the equipment. Louvres to have drainable blades.
4. Provide galvanized wire mesh 'bird' screen with each louvre and wall cap.
5. Locate air intake louvres a minimum of 76cm (30") above the building finished roof or 198cm (78") above grade level. Consider local snow fall and drifting or other conditions which may warrant increasing height above grade level or roof level

## Section 23 38 00 Ventilation Hoods - Kitchen Grease Exhaust Hoods

1. Kitchen Grease Exhaust Hoods and Exhausters
  - 1.1. An Underwriters Limited Canada (ULC) listed and labeled grease exhaust hood with welded exhaust ducting and a roof exhauster with backdraft damper at the point of discharge to the outside is required and shall be in accordance with NFPA-96 (NFPA (Fire) 96: 2017).
  - 1.2. Hood shall be minimum 18gauge welded stainless steel complete with stainless steel filters, a ULC listed fire damper and balancing damper, (where applicable), welded duct collar, a flush mounted LED light fixture incorporated into the unit and shall be constructed with an integral 76mm (3") airspace (double wall construction) on the rear side. Entire hood and fan system shall be installed to NFPA 96 requirements, latest edition.
2. V-belt drives shall be of canvas and rubber construction of approved manufacture having a matched belt drive to prevent slippage and undue wear upon starting. Drives shall be multi- belt, none having less than two and shall be designed for 150% of the specified motor nameplate rating.

## Section 23 40 00 HVAC Air Cleaning Devices

### 1. Air Filters and Filter Gauges

- 1.1. Filter media shall be UL listed, Class I or Class II, as approved by local authorities. Ensure that filter sections are supported with acceptable documentation with respect to resistance to air flow at design air velocities.
- 1.2. The filter selections shall be based on published ratings of dust holding capacity, arrestance, and efficiency. Ratings shall be based on ASHRAE 52.2 (ASHRAE 52.2-2017) criteria.
- 1.3. Fabricate filter frames and supporting structures of galvanized steel with necessary gasketing between frames and walls. Provide holding frames with "T" section construction. Provide standard size frames to allow filter media of multiple manufacturers.
- 1.4. Provide galvanized steel blank-off plates as required, to fit all openings.
- 1.5. Panel Filters
  - 1.5.1. Extended surface high loft pleated media, moisture resistant frame, welded wire pleat support grid with the media bonded to the grid and the frame. Minimum MERV 8 efficiency.
  - 1.5.2. Pre-filters shall be moisture resistant polyester panel filters with internal steel wire support suitable for mounting in a standard filter track. Provide minimum 16-gauge galvanized steel or extruded aluminum metal holding frames containing 11 gauge wire mesh on leaving air side. Minimum MERV 8 efficiency.
- 1.6. Cartridge Type Filters
  - 1.6.1. Disposable pleated synthetic media type with corrugated separators.
  - 1.6.2. Housing shall consist of galvanized steel or aluminum sides and headers with perimeter gaskets.
  - 1.6.3. Minimum MERV 14 efficiency.
- 1.7. High Efficiency Bag Filters (allowed only if specific written permission is obtained from DPW)
  - 1.7.1. Media shall be reinforced synthetic preformed into a series of pockets and bonded to a header. Minimum MERV 14 efficiency.
  - 1.7.2. Holding frames shall be galvanized steel or extruded aluminum with sealing grooves, gaskets and locking clips.

- 1.8. Specialized Filters (e.g. activated carbon for odour control)
  - 1.8.1. May be required depending on site conditions.
  - 1.8.2. Media shall be regenerative activated carbon with 50-55 minute absorption capacity in accordance with the standard accelerated chloropicrin test. Provide adequate filtration for dusting from the activated carbon.
  - 1.8.3. Housing shall consist of galvanized steel or aluminum sides and headers with perimeter gaskets.
  - 1.8.4. Provide a detachable test element to indicate the extent of saturation of the media.
- 1.9. Locate filters for straight-through unrestricted air flow to eliminate turbulence, dead air spaces and eddy currents. Construct and install filters to prevent passage of unfiltered air. Provide closed cell foam, rubber or neoprene gaskets.
- 1.10. Ensure proper and safe access to filter for servicing.
- 1.11. Provide bird screens on outside air intakes and provide weather protection for filter banks.
- 1.12. Filter Gauges
  - 1.12.1. Provide a permanent dial type filter gauge for each filter bank and remote indication if equipment is located in areas of difficult access.
  - 1.12.2. Select gauges with ranges appropriate to the filter manufacturer's maximum permissible pressure drop.
  - 1.12.3. Gauges shall have pointer flags set to the filter manufacturer's pressure drop for the clean (new) condition and also for the maximum permissible pressure drop i.e. the recommended replacement (dirty) value.
- 1.13. Replace filters used during testing and commissioning period. Filter media to be new and clean, as indicated by the filter gauges, at the time of acceptance



**Section 23 51 00 Breeching, Chimneys and Stacks (Natural Gas, Propane, Biomass)**

1. Mechanical engineer to size breeching and chimneys to handle peak gas flow at the design gas temperature and excess air so that the over fire boiler draft will be as per manufacturers recommendation, and as per code and CSA Standards.
2. Chimneys shall be a minimum of 274cm (9') above the highest point of the highest roof on the building. Mechanical engineer must determine if conditions warrant a higher stack. Dispersion modeling shall also be carried out (not by mechanical designer) to confirm if the design stack heights and the ventilation system configurations are sufficient. If the modeling indicates additional stack heights or other measures are required to ensure proper air quality in the building, mechanical designer shall make changes necessary to accomplish this.
3. Breeching
  - 3.1. Shop fabricated, 14 gauge all welded mild steel, or prefabricated, double walled insulated systems as per chimney section. Prefab systems must be rated for use as a breeching.
  - 3.2. Attach to boiler using fully sealed flanged connection.
  - 3.3. Suspend breeching at 183cm (6') centres and at each joint on horizontal runs.
  - 3.4. Connect breeching branches at 45 degrees to main breeching.
  - 3.5. Provide thermometer on breeching branch to each boiler.
4. All Fuels Pressure Chimney
  - 4.1. ULC labelled, 538 deg. C (1000 deg. F) (continuous) rated, all fuels.
  - 4.2. Sectional, prefabricated, double wall with minimum of 25mm (1") mineral wool insulation with mated fittings and couplings.
  - 4.3. To ensure gas tightness, all joints shall be flanged, and chimney systems shall be factory tested and approved to 152cm (60") w.c.
  - 4.4. Liner shall be minimum 0.876mm (0.0345") thick, 316 stainless steel.
  - 4.5. Shell shall be 304 stainless-steel.
  - 4.6. 90 deg. Tee, straight pipe and flue connector are to suit the application.
  - 4.7. Support chimneys at bottom (preferably above base tee), and install guides and flashing components, as required.
  - 4.8. Install flashings on chimneys, as required.
  - 4.9. Install cones, cleanouts and drains, as required.
  - 4.10. All fasteners and screws used to assemble chimney to be stainless steel.

- 4.11. Follow manufacturer and SMACNA installation and recommendations for shop fabricated components. Chimneys shall be offset from boilers complete with base cap and drain.
  - 4.12. Install chimney to manufacturers recommendations complete with all required components. Particular attention shall be paid by the design engineer and contractor to the overall integrity of the breeching and chimney system and its penetration through the building structure. Design engineer to provide written confirmation of his visual inspection of the complete system (before it concealed by insulation and/or the building construction).
5. Accessories
- 5.1. Cleanouts shall be bolted, gasketed type, full size of breeching, as indicated. Provide so that all section of breeching can be cleaned and inspected.
  - 5.2. Hangers and supports shall be in accordance with the recommendations of the Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA) and the chimney manufacturer.
  - 5.3. Exit cone, storm collar, guy system (if applicable including guy section, wire and tensioners), flashing components, alignment guide, wall support, base tee, drain cap, drain shall be in accordance with the chimney manufacturers recommendations.
  - 5.4. Base cap and drain are to be accessible and have a disconnect and trap.
  - 5.5. Ensure wire guy tensioners allow for expansion and contraction of new chimney. A suitable galvanized structural steel guy frame above the roof line is also acceptable if guying is required.
  - 5.6. Apply at least one coat of corrosion resistant primer and paint to fabricated supports made of ferrous metal.
  - 5.7. Apply cold galvanized zinc metal touch-up as required on galvanized metal work.

**Section 23 52 00 Heating Boilers**

1. Primary heat generation shall be provided by hot water boilers rated for and certified for oil firing. The boilers shall also be rated for and certified for firing of natural gas. Plates/decals on boilers to indicate these certifications. The boiler plant typically consists of two fire tube or cast-iron boilers. Other boilers may be accepted with written permission from DPW.
2. Domestic hot water shall be heated by the main building heating plant with this plant incorporating sufficient capacity to provide indirect domestic hot water heating. A separate domestic hot water boiler serving indirect domestic hot water heaters shall be provided where the summer load is below the minimum safe turn down ratio of the smallest main building heating plant boiler. Other systems/equipment may be considered but will be allowed only with written permission from DPW (also refer to Part 2, related Facility Services Subgroup Divisions 20-29 for facility specific detailed design requirements). Where a separate boiler for domestic hot water is required, provide piping and valves so that the main heating plant boilers can be used to heat the domestic hot water at the discretion of the building operator.
3. Establish the capacities, arrangement and number of boilers such that when any one boiler in the main building heating plant (i.e. excluding the separate boiler for domestic hot water if present) is out of service, the remaining boilers in the main building heating plant shall be sufficient to offset the full building transmission heat loss. Note that this excludes heat for ventilation. Select boiler sizes to provide the maximum operating efficiency and cost effectiveness for the facility.
4. The main boiler hydronic systems shall utilize treated fresh water. Through heat exchangers, secondary hydronic loops of 40% propylene glycol solution or thermal fluid shall serve heating units requiring freeze protection.
5. Boilers shall be provided with individual chimneys.
6. Fire tube boilers shall be mounted on a steel frame with forced draft burner and all necessary controls. The entire unit shall meet CSA requirements and be constructed in strict accordance with ASME requirements. Provide two lifting eyes on top of boiler. Hinged front and rear doors shall be gas tight, insulated and secured with heavy duty cap screws and replaceable brass nuts. Front and rear tube sheets and flue shall be fully accessible for inspection and cleaning when doors are open. Provide observation ports at each end of boiler. Provide adequate handholes and armholes for boiler inspection and cleaning. Provide a spring-loaded relief door with gasket seat. Insulate casing with readily removable mineral fiber insulation covered by sectional preformed sheet metal jacket. Boiler casing temperature shall not exceed ambient boiler room temperature by 10 deg. C (50 deg. F) maximum with surface air velocity of 0.3 m/s. Factory paint boiler, base and other components with hard-finish silicone enamel.

7. Cast iron boilers shall have a sectional cast iron heat exchanger (conforming to ASME requirements and tested for a maximum working pressure of 100 kPa - 200 kPa) with glass fibre rope gasket material carefully installed between sections and be mounted on a structural steel base with front plate, removable panels and lifting lugs. Provide forced draft burner and all necessary controls. Insulate entire boiler with mineral fiber and finish with steel cover jacket with factory applied baked enamel. Provide adequate clean-out and access doors, and openings including observation ports and relief openings. Torque boiler sections together as per manufacturers recommendations and provide a written report indicating the final torque readings. In addition to the normal hydrostatic test on the water side, sectional boilers shall be tested for leakage on the gas side after the sections are assembled by applying soapy water to each joint while maintaining a minimum air pressure of 76mm (3") w.c. This test must be witnessed by the mechanical design engineer or person authorized by the mechanical design engineer and also the DPW mechanical inspector. Contractor to provide a written report indicating the results of this test. Provide a minimum of four working days notice of the time for this test.
8. Boiler shall fire light oil (and be certified for future natural gas firing) and be complete with all standard accessories including modulating oil burner, minimum 51mm (2") thick insulation (on all sides, top and bottom) under sectional preformed metal jacket (both readily removable and reinstalled), float operated low water cut-off, pressure gauges, automatic water feeder, ASME safety relief valve, and all necessary controls for safe automatic operation. The boiler-burner combination must be approved as a package from an accredited testing organization (e.g. ULC ) and documentation of this approval shall be reviewed and confirmed by the mechanical design engineer.
9. Low water cut-offs shall be piped with test-n-check valves and air vent for testing of the low water cut-offs without draining down the boiler.
10. All boiler temperature and pressure gauges shall be calibrated in both metric and imperial and shall be the dual temperature and pressure type.
11. Units shall be complete with necessary control transformers in a pre-wired control panel.
12. Control panels shall be complete with wiring diagrams.
13. Boiler-burner combination shall be factory rated and guaranteed to operate at a minimum fuel to hot water efficiency of 80% for firing rates of 40% to 100%.
14. The boiler-burner shall be started up and put into operation by factory trained representatives of the manufacturers (who must be a licensed burner mechanic). The complete boiler package shall be tested to check construction, operation and function of all controls, and performance. A written report of the start-up shall be provided to DPW indicating CO<sub>2</sub>, smoke, pressure, and flame readings (readings shall be taken with an electronic analyzer with a copy of the actual test print out included in the report). The licensed burner mechanic shall also sign the report.

Factory trained representatives of the manufacturers shall also provide on-site instruction (minimum four hours) in operation and maintenance procedures for the to the building operators.

15. The design and installation shall be such that the minimum return water temperature to the boilers and maximum temperature differential between the supply and return water (under all operating conditions) is per the boiler manufacturer's recommendations. See also Heating Design Considerations in related Facility Services Subgroup Divisions, including Division 25
16. Circulator pumps are required at boilers for thermal break.

## Section 23 57 00 Heat Exchanger/Converters

### 1. Plate Heat Exchangers

- 1.1. Plate shall be constructed of type 316 stainless steel and shall be a double gasket design to prevent mixing of the two fluids. Gaskets shall be nitrile or EPDM as recommended by the manufacturer. Minimum design pressure to be 689kpa (100psig) at 135 deg. C (275 deg. F).
- 1.2. Heat exchangers to be hydrostatically tested at one and one half times the design pressure prior to shipping. Each unit to be designed to Section VIII, Division 01 of the ASME code and name plate stamped accordingly.
- 1.3. Capacity and heating surface of convertors shall be based on water and/or glycol conditions.
- 1.4. Heat transfer plates shall be secured in a heavy-duty epoxy painted carbon steel frame.
- 1.5. All connections 64mm (2½") and over shall be flanged.
- 1.6. Convertors shall set horizontally with sufficient clearance between convertors.
- 1.7. Piping to convertor shall be complete with shut-off valves.

### 2. Tube-in-Shell Heat Exchanger

- 2.1. Units shall be designed for heating fluid in shell and heated fluid in tubes.
- 2.2. "U" tube type with 20 mm minimum seamless copper tubes with brass tube support suitable for 1030 kPa working pressure. Maximum tube velocity shall be 1.2 m/s.
- 2.3. Water chamber and tube bundle shall be removable for inspection and cleaning. Prime coat exterior of units. Ensure installation permits removal of tubes without disturbing installed equipment or piping. Provide for temperature regulator sensor at water outlet.
- 2.4. Heating media in shell shall be 2 pass design, tube side may be 4 pass design.
- 2.5. Shall be designed, constructed and tested in accordance with ANSI/ASME Boiler and pressure Vessel Code, Section VIII, CSA B51(CSA B51:19) and provincial pressure vessel regulations.
- 2.6. Shell shall be steel designed with 150 psi working pressure. All connections 64mm (2½") and over shall be flanged. All connections 51mm (2") and under shall be 1361kg (3000 lb.) couplings.

- 2.7. Head shall be cast iron or fabricated steel. Provide tappings for relief valve, thermometers and pressure gauges, drain and vacuum breaker.
- 2.8. Tube sheet shall be steel.
- 2.9. Mounting supports shall be steel or cast-iron saddles with attaching U-bolts.

**Section 23 70 00      Central HVAC Equipment**

1. Air Handling Units

- 1.1. Packaged air handling units shall be designed in accordance with the latest ASHRAE Standard 62 (Standard 62.1-2007) "Ventilation for Acceptable Indoor Air Quality".
- 1.2. Insulation and Liner
- 1.3. Insulate unit panels with 51mm (2") thick neoprene coated rigid fibrous glass or foam insulation (minimum density of 24kg/m<sup>3</sup> (1.5 lbs./cu.ft)). Cover with minimum 20-gauge solid galvanized sheet metal.
- 1.4. Fans - refer to Section 23 30 00 HVAC Air Distribution and related sub-sections
- 1.5. Filters - refer to Section 23 40 00 HVAC Air Cleaning Devices, and related sub-sections.
- 1.6. Humidifiers - refer to Section 23 84 00 -Humidity Control Equipment and related sub-sections.
- 1.7. Casing
  - 1.7.1. Heavy formed structural steel framework shall be used to mount equipment and support exterior steel panels. Reinforce panels where required. Minimum exterior casing thickness shall be 18 gauge with outdoor units minimum 16 gauge.
  - 1.7.2. Provide hinged access doors complete with fasteners and gasket seals in all sections to allow for easy servicing of components. Doors shall be minimum 152cm (5'-0") high. If the unit height will not accommodate 152cm (5'-0") high doors, doors shall equal unit height less 152mm (6"). Door width shall be 457mm (18") or 102mm (4") less than section length. Provide double glazed glass windows in access doors for fan and humidifier sections.
  - 1.7.3. Provide heavy duty marine type lights inside units in fan and humidifier sections. Provide light switches on outside of unit adjacent access doors.
  - 1.7.4. Construct indoor units of galvanized steel. Construct outdoor units of galvanized steel with exterior surfaces epoxy coated in colour of Owner's choice. Weld or bolt and seal seams and mount on galvanized steel roof curb with wood nailing strip. Outdoor units shall be provided with weather hoods and storm proof louvres on both the supply and exhaust sides.



- 1.7.5. Drain pans shall be IAQ type (sloped in two planes) insulated double wall stainless steel. Ensure no standing water at any time or at any point (after air handling unit has been installed ensure proper drainage of water). Provide a drain connection at the low point (recessed with no lip) of each pan which shall be connected to a 32mm (1¼") drain with deep seal trap discharging on the access side of the unit. Indoor unit drains shall be piped with copper or PVC-DWV from the pan, through to the traps and then to a funnel floor drain. At the minimum, a separate trap shall be provided for pans on each side of every filter bank in the unit to prevent air bypass around the filters through untrapped drain lines. Trap depth shall be a minimum 150% of the unit maximum static pressure; unit mounting height shall be such that mechanical room floor does not require cutting/gouging to accommodate the trap. Provide an electronic primer on each trap. Outdoor units shall have traps drainable for freezing conditions. Pans are to be coated with an anti-microbial agent. Drain pans shall be provided in the furthest upstream section of the unit and from there downstream until (and including) the section after the pre-filters, in all coil sections, the heat recovery section, (both the supply and exhaust sides) and humidifier section.
- 1.7.6. Units shall be provided with vibration isolation.
- 1.8. Coils
  - 1.8.1. General Design Considerations
    - 1.8.1.1. Design air handling unit and mixing chamber (if applicable) to ensure even air temperature distribution across the face of coils.
    - 1.8.1.2. Wet coils shall not exceed the recommended carry over face velocity. Make face velocity corrections for uneven distribution.
    - 1.8.1.3. Water velocity shall not exceed 7 fps.
    - 1.8.1.4. Coils deeper than 6 rows are not recommended.
    - 1.8.1.5. Design coil banks to allow independent coil isolation, drainage, venting and maintenance operations.
    - 1.8.1.6. The air handling systems shall be on a separately scheduled circulation loop. Each coil shall also have its own 2 or 3-way valve. Prevent coils from being exposed to freezing conditions during both system shut-down and normal operation, e.g. use high efficiency mixing boxes, outside air dampers with negligible leakage, and maintain circulation. Coils shall utilize a pre-mixed 40% propylene glycol water

solution (with inhibitors) unless specific written permission to do otherwise is obtained in writing from DPW. Glycol fill systems shall have a motorized pump.

- 1.8.1.7. Provide access for maintenance and replacement on both sides of coils.
- 1.9. Provide hinged access doors not less than 102mm x 152mm (4" x 6") for access to motor and fan shafts for test purposes.
- 1.10. Operating Dampers - See Div 25 Integrated Automation for operating damper requirements.

**Section 23 72 00      Air-to-Air Energy Recovery Equipment**

1. General

- 1.1. Heat recovery systems shall be used where high ventilation rates are implemented.
- 1.2. Analysis shall be carried out by the mechanical designer so that it is clear the heat recovery system selected will minimize owning, operating and maintenance costs over the life of the building.
- 1.3. Several methods of energy recovery are indicated below, other types may be considered but will be allowed only with written permission from DPW.
- 1.4. Install to manufacturer's recommendations. Install access doors in duct at entry and exit of reclaim devices.

2. Energy Recovery Wheels

- 2.1. Energy recovery units shall be rotary air-to-air heat exchangers having equal latent and sensible efficiency. The latent and sensible efficiencies shall have been tested in accordance with the latest ASHRAE performance guidelines. The transfer media shall be non-asbestos, in accordance with NFPA and pass UL and ASTM flame and smoke tests. The rotor shall be constructed of corrugated aluminum treated with inorganic compounds and strengthened with radial spokes for rigidity. The desiccant coating shall be bacteriostatic, non-toxic and non-corrosive.
- 2.2. The transfer media shall not allow airflow to be radial and shall be capable of passing solids up to 300 microns. The transfer media shall, when exchanging energy at the efficiency specified, run dry to the touch.
- 2.3. The casing of the rotary heat exchanger shall have a built-in purge section allowing a maximum cross contamination of particulate to 0.01% by volume of exhaust air.
- 2.4. The unit casing shall be constructed of minimum 10 gauge welded structural steel to ensure rigidity and stability and shall be galvanized after manufacture. Casing side panels shall be removable to provide easy access to internal parts. Unit shall be factory assembled, tested and shipped as one piece.
- 2.5. Seals shall be provided on periphery of the rotor as well as on duct divider and purge section. Seals are to be spring loaded, adjustable and constructed of neoprene. Seals are to be held in place with clips fastened to stud welded bolts and compressed by a retaining band. The required seal clearance is to be factory set and checked at installation.

- 2.6. The rotor shall be driven by a belt around the outside of the rotor powered by a variable speed fractional h.p. A/C motor. Variation of motor speed shall be accomplished via an adjustable frequency A/C motor drive.
  - 2.7. The drive motor and thermostat body shall be factory mounted and wired on the side panel of the rotary air-to-air exchanger.
  - 2.8. The manufacturer must have a minimum of 5 years' experience in the manufacturing of rotary energy recovery wheels. The wheels shall be set up and put into operation by a factory trained representative of the manufacturer, who shall also provide on-site instruction (minimum four hours) in operation and maintenance procedures to the building operators.
  - 2.9. Also to be included in the contract is service and preventative maintenance for energy recovery wheels which shall be performed by factory trained technicians and tradesmen a minimum of four times per year during the warranty period. The warranty period for energy recovery wheels shall be extended to two years. During this period, the energy recovery wheel systems shall be inspected and serviced, and any deficiencies present shall be corrected. Following each service visit, a report shall be submitted to DPW indicating the items checked and service work performed, and the condition of the equipment. The contractor shall also consult with the building maintenance supervisor on each trip regarding the performance of the equipment.
3. Air to Air Fixed Plate Exchanger
    - 3.1. Casing shall be 20 gauge galvanized steel. Heat transfer surfaces shall be corrugated aluminum, edge sealed and bonded to the casing. Condensate drain to be DN 50 (NPS 2). Provide removable access panels. Cross contamination of airstreams is not permitted
4. Run Around Coil System
    - 4.1. A run around loop is a built-up system rather than a manufactured item and is specified in the appropriate sections. Run around loops shall be charged with a 40% propylene glycol solution.
5. Dual Core Heat Exchanger
    - 5.1. A packaged heat recovery unit which utilizes two energy cores and an internal damper configuration which cycles on a set basis to absorb and emit heat to and from the airstreams shall be allowed.
6. Energy recovery equipment shall be insulated with 51 mm (2") thick mineral fibre insulation. Provide insulation and liner as for air handling unit panels where appropriate. See also Facility Services Subgroups- General (FSS-G), Equipment Insulation.

**Section 23 80 00      Decentralized HVAC Equipment**

1. Electric Heating

- 1.1. The use of electric heating must be approved in writing by DPW before proceeding.
- 1.2. In electrically heated buildings, evaluate and determine the type of heat source required including but not limited to the following:
  - 1.2.1. Natural Convection Heaters
    - 1.2.1.1. Baseboard heaters.
    - 1.2.1.2. Draft barrier heaters.
    - 1.2.1.3. Architectural convection heaters.
    - 1.2.1.4. Ceiling infrared heating.
    - 1.2.1.5. Floor infrared heating.
    - 1.2.1.6. Mechanical duct heaters.
    - 1.2.1.7. Pipe heat tracing.
    - 1.2.1.8. Snow melting cables.
    - 1.2.1.9. Electric furnaces.
  - 1.2.2. Forced Air Heaters
    - 1.2.2.1. Ceiling unit heaters.
    - 1.2.2.2. Wall unit heaters.
- 1.3. Baseboard type heaters are to be commercial grade, low watt density. Cabinets shall be finished with two coats of baked enamel in ivory colour.
- 1.4. All electric type heaters shall be controlled by wall type thermostats. Integral type thermostats are not permitted.
- 1.5. Electrical heating systems shall have a high temperature cut-out that will automatically discontinue current to the heating elements if the temperature exceeds the maximum safe limits.

**Section 23 82 00      Convection Heating and Cooling Units**

1. Heating
  - 1.1. Provide heat at all windows and clerestory glazing.
2. Electric Heating
  - 2.1. Electric resistance heating will only be considered where an owning and operating cost advantage is indicated by a comparative cost study of alternative heating systems (for example, in a remote vestibule a long distance from a boiler room). The use of electric heat requires approval in writing from DPW
3. Finned-Tube Radiation Heaters
  - 3.1. Wall Finned-Tube Radiation (for educational facilities, not permitted in learning spaces or administration areas and permitted in cafeterias and gymnasiums only if mounted at high level)
    - 3.1.1. Finned- tube radiation shall be of the non-ferrous type, aluminum fins, 32mm (1¼") seamless copper tube, enclosure shall be constructed of minimum 16-gauge steel complete with hanger, brackets, etc. Use double slope enclosures in educational facility gymnasiums.
    - 3.1.2. Enclosures shall be complete with access doors complete with cam locks to all valves, vents, etc.
    - 3.1.3. Provide end caps on all radiation. Where wall-to-wall, sufficient space shall be left for removal of end cap, but not greater than 76 mm (3"). Provide end filler pieces which do not cover any of the radiation grille.
    - 3.1.4. Elements shall have 114mm x 114m (4½" x 4½") aluminum fins and shall be designed for use at 1724kpa (250psi) with 149 deg. C (300 deg. F) water.
    - 3.1.5. All radiation enclosures, and accessories shall be prime coated with a baked enamel primer.
    - 3.1.6. Performance shall be based on 82 deg. C (180 deg. F) average water with a -7 deg. C (20 deg. F) temperature drop and 18 deg. C (65 deg. F) entering air
    - 3.1.7. Radiation fin elements shall be supported on roller bearing, two piece saddle type hangers.
    - 3.1.8. Radiation Installation

- 3.1.8.1. Install a compressible sealer strip extending the full length of enclosure.
- 3.1.8.2. Joiner pieces shall be of such a length so as not to cover any part of grille. Use butt type joints.
- 3.1.8.3. Where element lengths are less than 50% of the enclosure length, the element shall be broken into two (2) sections spaced equally in the enclosure
- 3.1.8.4. Radiation interconnecting piping shall be type L copper, with wrought copper fittings and joints 95-5 soldered.

#### 4. Panel Radiators

- 4.1. Radiators shall be manufactured of cold rolled low carbon steel, fully welded and consisting of header pipes at each end.
- 4.2. Radiator header pipes shall include all necessary supply, return and air vent connections. Internal baffling shall be provided as required.
- 4.3. Standard piping connections shall be 19mm (¾") NPT taper threaded sockets, located in either side, or vertical positions. Air vent connections shall be c" NPT taper threaded sockets.
- 4.4. Working pressure shall be medium pressure: 586kpa (85psi) max. (tested at 758kpa (110 psi)).
- 4.5. Radiator expansion shall not exceed 1.3 mm/linear m (0.016"/linear ft) at 102 deg.C (215 deg. F). Expansion compensation shall be provided in the piping as required.
- 4.6. Radiators shall be phosphatized and primed with flat white baked enamel.
- 4.7. Radiators shall be finish painted with a gloss baked enamel for a total paint thickness of 2 to 3 mils.
- 4.8. Wall mounting brackets, joiner pieces, hold down clips etc., shall be provided with radiators.

#### 5. Unit Heaters

- 5.1. Unit heater casing shall be of 16 ga. steel with all corners rounded, gloss enamel finish, threaded connections for hanger rods.
- 5.2. Coils shall be constructed from seamless copper tubing with mechanically bonded aluminum fins evenly spaced. Coils shall be of the flat plate type and tested to a minimum of 1207kpa (175psi).
- 5.3. Fans shall be of the direct drive standard propeller type, machined and balanced to eliminate vibration. Horizontal models shall be complete with sleeve bearings and a fan guard. Vertical models shall be complete with grease lubricated ball bearings.

- 5.4. Motors shall be totally enclosed of standard pattern for the duty. Motors shall be mounted out of the heater air stream.
- 5.5. Each unit shall be equipped with a multiple louvered type diffuser. Provide an adjustable pattern diffuser on vertical models and four-way louvres on horizontal models.
- 5.6. Units shall be controlled by a wall mounted thermostat/temperature sensor with a metal cover and guard.
- 5.7. Cabinet Unit Heaters
  - 5.7.1. Coils shall be copper tube extended surface type with mechanically bonded aluminum fins.
  - 5.7.2. Fans shall be quiet operating, forward curved, centrifugal blowers properly balanced to provide quiet operation, direct drive by silent operating non-radio interference vibration isolated capacitor motors of standard manufacture.
  - 5.7.3. Cabinets shall be minimum 16 ga. steel, phosphatized, prime coated for finishing after installation.
  - 5.7.4. All units shall have a three (3) speed switch and manual starter accessible through an access door in the front cover.
  - 5.7.5. Units shall be controlled by a thermostat/temperature sensor with a metal cover and guard mounted on the opposite wall.
  - 5.7.6. Heaters shall be wall mounted only. Airflow to be in on the front panel at the top and out at the bottom panel. Heaters shall have recessed installation.



## Section 23 83 00 Radiant Heating Units

### 1. Radiant Ceiling Panels

- 1.1. The radiant ceiling panels shall consist of extruded aluminum having an overall thickness of approximately c". Copper tubing of 12.7mm (½") I.D. shall be mechanically attached to the aluminum faceplate. There shall be a non-hardening heat conductive paste between the copper tubing and the aluminum faceplate.
- 1.2. Panels shall be of adequate width. The length shall be from wall to wall in typical rooms. Panels shall be constructed of 152mm (6") wide aluminum extrusions and shall be held flat with cross braces on electro-galvanized, chromate-dipped saddle brackets and spring clips.
- 1.3. Panels shall be finished in the manufacturer's standard white colour (or as selected by the Engineer).
- 1.4. Performance shall be based on an 82 deg. C (180 deg. F) mean water temperature (MWT) in a room with 21 deg.C (70 deg.F) air temperature and natural convection.
- 1.5. Installation
  - 1.5.1. Supply and install 51mm (2") thick foil faced fibreglass insulation overactive panels (refer to insulation section). Insulation foil face shall be installed up, seal all edges of foil with tape so that there is no exposed insulation (insulation not required for radiant panels installed below fire rated ceilings)
  - 1.5.2. Interconnecting of radiant panels shall consist of 12.7 mm (0.500") O.D. soft copper tubing or accessories as recommended by manufacturer, i.e., factory supplied 360° inter-connecting loops and 180° return U-bends. Supply first to panel tubing pass closest to perimeter wall. Multiple panels shall be circuited to ensure serpentine flow over complete length of zone. Individual serpentine panel coils connected in series is unacceptable for multiple panel zones. Connecting loops to be laid flat to prevent air locking.
  - 1.5.3. All radiant panels shall be installed by personnel wearing clean white gloves to avoid soiling the panel face.
  - 1.5.4. Where lay-in panels are to lay in a suspended T-bar ceiling grid, coordinate metric or imperial sizing. All panels are to be supported by the T-bar and safety wire spaced 4' on centre, two hanger wires per cross brace, or as recommended by the manufacturer, whichever is the most stringent. Where cross T's are used between panel ends, the cross T's shall be flush with the exposed edge of the moulding.

- Provide channel moulding at walls and secure tees where panels butt together.
- 1.5.5. Where panels are to be recessed into a gypsum board ceiling, the panels shall be supplied with a recessed frame of extruded aluminum. The frame shall be painted to match the radiant panels and shall have a 1mm (0.04") thickness by 25mm (1") wide exposed flange with neat, mitred corners. Install the panel in the ceiling and secure with safety wire.
  - 1.5.6. Where the ceiling is fire rated, install the radiant panels below the ceiling membrane.
  - 1.5.7. Hold down clips to be provided at all brackets front and back, for T-bar and drywall ceilings.
  - 1.5.8. The last two feet of the run out connecting into the panel to be Type L soft copper only.
  - 1.5.9. All system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected into the system.
  - 1.5.10. No installation of radiant ceiling panels shall begin until all glazing has been completed and all exterior openings closed in. All wet work, including cement, plaster ring, terrazzo, etc., shall be completed and dried out before radiant ceiling panels are installed.
2. In-floor Radiant Heat
- 2.1. Insulate floor under all in-floor radiant heat with minimum 51mm (2") insulation.
  - 2.2. Tubing shall be cross linked polyethylene, rated at 82 deg. C (180 deg. F) and 689kpa (100psi) working pressure and in accordance with ASTM F876 (ASTM F876-17). Tubing shall have an oxygen diffusion barrier capable of limiting diffusion to 0.02 grains/cubic foot/day.
  - 2.3. The tubing shall have a safe bending radius of 152mm (6").
  - 2.4. Fittings shall be of corrosion resistant brass and consist of an insert, serrated compression ring and nut. Fittings to be supplied by the tubing manufacturer.
  - 2.5. Manifolds bodies shall be constructed of cast brass with brass supply and return piping adapters. Provide air vents, drains, thermometers, and installation brackets for each manifold. Each radiant loop (circuit) shall have a balancing and shut off valve.
  - 2.6. Provide individual valves (telestats) for each zone where the manifold serves multiple zones and a single control valve where the manifold serves a single zone.

- 2.7. Piping to be installed at maximum 30cm (12") centres and secured to wire mesh with wire ties spaced at 91cm (3') maximum on straight runs. At 180-degree bends provide a minimum of three ties.
- 2.8. Prior to the installation of the concrete, the piping system shall be pressurized to 276kpa (40psig) with this pressure maintained for a minimum of 24 hours. The piping shall also be maintained at this pressure until the concrete has set.
- 2.9. Manifolds shall be in the walls unless written permission is received from DPW.
- 2.10. Contractor shall have installer on site during all concrete pours
3. Note: Residential style baseboard radiation will not normally be allowed and will be permitted only if specific written permission is obtained from DPW.

## Section 23 84 00 Humidity Control Equipment

### 1. Humidifiers

- 1.1. Direct boiler steam humidifiers are not to be used. Natural gas or propane fired humidifiers are also not approved for use. Humidifier types other than those noted below may be considered but will be allowed only with written permission from DPW.
- 1.2. The mechanical design engineer shall coordinate water quality testing at or near the building site to determine hardness, conductivity etc. These and other relevant parameters shall be measured with the humidifier type and corresponding water treatment systems selected and sized using the test results. The acceptable products considered for the project must all be capable of utilizing the water provided to the humidifiers. The mechanical design engineer shall obtain written confirmation from each manufacturer of such capability and provide a written report to DPW with recommendations on the humidifier type and water treatment systems to be provided.
- 1.3. Electronic Humidifiers
  - 1.3.1. Humidifiers shall be self-contained, microprocessor controlled, electrode or coil steam generating, with CSA and ULC approval.
  - 1.3.2. Shall have electronic capacity control (25-100%) and solenoid control of supply and drain lines.
  - 1.3.3. The rated steam output shall be the net of the unit rating after allowance for heat lost in water drained from the unit.
  - 1.3.4. Water supply shall be 6.4mm (¼") tubing with ball valve shut off, and drain shall be 25mm (1").
  - 1.3.5. Humidifiers shall be set up and put into operation by a factory trained representative of the manufacturer, who shall also provide on-site instruction (minimum four hours) in operation and maintenance procedures to the building operators.
  - 1.3.6. Controls to include solid state panel, solenoid valve on water and drain lines, humidistat (not required if provided by building automation), direct wired airflow proving switch, automatic drain/flush with selectable override, amp meter and cylinder replacement indicator light (for electrode type), electronic water level control (including high and low water cut off and skimmer functions), and shall be interlocked with the A/H unit for shut down of operation.

- 1.3.7. Also, to be included in the contract is service and preventative maintenance for electronic humidifiers and their associated water treatment systems which shall be performed by factory trained technicians and tradesmen a minimum of four times per year during the warranty period. The warranty period for electronic humidifiers and their associated water treatment systems shall be extended to two years. During this period, the humidification systems shall be inspected and serviced, and any deficiencies present shall be corrected. Following each service visit, a report shall be submitted to DPW indicating the items checked and service work performed, and the condition of the equipment. The contractor shall also consult with the building maintenance supervisor on each trip regarding the performance of the equipment.
- 1.4. Steam to Steam Humidifiers
  - 1.4.1. Steam fired evaporative humidifiers shall use low pressure steam to generate humidification steam.
  - 1.4.2. Construction
    - 1.4.2.1. Vaporizing chamber, cover and fittings shall be stainless steel with Heli-arc welded seams.
    - 1.4.2.2. Tank and cover shall be constructed of stainless steel.
    - 1.4.2.3. Cover shall be quick removal type using threaded knobs; gasket shall be held in place by flanges that are formed as part of the cover and evaporating chamber; flanges shall interlock to lock the gasket between them.
    - 1.4.2.4. Vaporizing chamber and front cover plate shall be easily removable for access to the vaporizing chamber for removal of loose scale.
    - 1.4.2.5. Heat exchanger shall be constructed of copper alloy tubes and header with welded joints.
  - 1.4.3. Accessories
    - 1.4.3.1. Steam valve shall integrate with the building system controls.
    - 1.4.3.2. Provide steam trap and strainer; trap to be float and thermostatic.
    - 1.4.3.3. Humidifier shall be covered with 19mm ( $\frac{3}{4}$ " ) thick reinforced aluminum foil faced mineral fibre insulation; all surfaces except the front face panel shall be insulated.

- 1.4.3.4. Water level control shall provide for automatic refill, and skimmer bleed-off functions.
  - 1.4.3.5. Water level sensing unit shall have 3 Teflon coated stainless steel probes screwed into a threaded probe head, with probe isolation shirts.
  - 1.4.3.6. Probe head shall be mounted on the front of the vaporizing chamber.
  - 1.4.3.7. Solenoid operated fill valve.
  - 1.4.3.8. Surface skimmer shall be provided which is field adjustable.
- 1.5. Controls
- 1.5.1. Control cabinet shall be a NEMA 12 enclosure. Control devices shall be mounted on a sub-panel within the enclosure. Cabinet shall be factory wired and mounted to the side of the humidifier.
  - 1.5.2. Controls to include solid state panel, solenoid valve on water and drain lines, humidistat (not required if provided by building automation), direct wired airflow proving switch, automatic drain/flush with selectable override, electronic water level control (including high and low water cut off and skimmer functions), and shall be interlocked with the A/H unit for shut down of operation.
- 1.6. Steam Dispersion Device
- 1.6.1. Tube banks shall consist of a horizontal header/separator and a designated quantity of vertical dispersion tubes to achieve the required steam capacity.
  - 1.6.2. Header and separator shall span the width of the air handling unit heating coil bank.
  - 1.6.3. Construction
    - 1.6.3.1. Header and separator shall be constructed of stainless steel and be fitted with nipples for dispersion tube connections.
    - 1.6.3.2. Tublets shall be non-metallic and designed for the steam temperature. Tublets shall extend through the wall of and into the center of the dispersion tube and incorporate a properly sized orifice.
- 1.7. All air handling units shall be provided with humidification systems to maintain minimum 30% relative humidity during winter design conditions.

2. Dehumidifiers

- 2.1. Swimming pool facilities shall be provided with a dedicated ventilation system featuring a packaged dehumidification ventilation unit, Pool dehumidification type unit, with heat recovery capability to assist in pool water heating or air stream heating.

**END**

## **DIVISION 25 - INTEGRATED AUTOMATION**

### **Section 25 00 00      Integrated Automation - General**

1. Varying, or deviating from any item(s) indicated in this document must be approved by DPW. DPW will not grant a deviation from these requirements unless the deviation has been submitted in writing for review and approved prior to proceeding with the design.



**Section 25 01 11      BAS: Start-up & Verification**

1. Inspecting & Testing of Controls Equipment
  - 1.1. The mechanical design engineer shall reserve the right to use any piece of electrical equipment, device, or material for such reasonable lengths of time and at such times as he may require to make complete and thorough tests of same before the final completion and acceptance. The contractor shall be advised so that he may have a representative present. Such tests shall not be construed as evidence of acceptance of any part of the contract, and it is understood that no claim for damage will be made by the contractor for any injury or breakage to any parts of the above due to the aforementioned tests where caused by weakness or inaccuracy of the parts or by defective materials of workmanship of any kind whatsoever.
  - 1.2. Tests shall be conducted until it has been demonstrated that the system performs as specified.
  - 1.3. The contractor shall provide full commissioning of the systems upon completion of field installation and when all equipment is in operation. Commissioning shall include a supervised, detailed calibration and function check of every separate point installed under the contract, together with a complete run-through of all functions on all building systems connected to ensure that all equipment, systems and circuits are functioning properly before completion of the contract. Commissioning shall be carried out by use of a commissioning point log sheet system, prepared jointly with designated personnel. After each point has been checked and confirmed to work, it shall be signed off by the contractor and designated personnel. The mechanical/controls design engineer shall verify that all equipment, systems and circuits have been fully tested, and are functioning properly as per the design. Refer to DPW's Consultant Agreement for further details.
2. DPW Performance Testing of Controls
  - 2.1. Testing of control hardware and software will be conducted by DPW after the controls contractor has completed the work and fully verified the operation of the system. The test program by DPW shall in no way be relied on by the controls contractor to determine the readiness of the control system.
  - 2.2. For educational facilities, hospitals and buildings over 20,000 square feet, the contractor shall provide a controls representative on site for two days to assist DPW testing and to be available to respond to telephone inquiries during the testing period. For other buildings, the controls representative is to be available to respond to telephone inquiries by DPW during the test period.

- 2.3. Any additional time required to correct deficiencies identified during testing shall be the responsibility of the contractor.

**Section 25 05 01      BAS: General Requirements**

1. The building controls shall consist of either direct digital controls (DDC) or electric-electronic controls. DDC systems are required for educational facilities, hospitals and generally buildings over 20,000 square feet. For other buildings and renovation projects, the mechanical design engineer shall consult with DPW on the size and type of control system required. This will be based on the size of the building, operational needs and economy.
2. For specific requirements related to DDC, refer to Section 25 30 01 Building Controllers.
3. Control systems shall utilize electric/electronic terminal devices. However, pneumatic actuators are acceptable on air handler dampers, on 3-way mixing valves for main circulation loops and on steam convertor control valves for existing buildings only, where pneumatic controls already exist.
4. Application specific controls for specific equipment shall have control features specified by the mechanical design engineer and shall be capable of interfacing with the overall building control system as needed for central monitoring and control of setpoints.
5. All control products (except equipment specific controls) shall be supplied by single vendor. Control devices serving similar functions shall be from the same manufacturer.
6. The controls must provide for all applicable control functions including those for space temperature control, humidity control, mechanical equipment operating schedules, building set back, hot water reset for space heating, air handler mixed air, cooling, heat recovery and heating, mechanical and electrical room ventilation, interlocks, critical alarm signals, freeze/fire shutdown where required and unoccupied shut down of air conditioning and ventilation to comply with the needs of the facility.
7. The control system is to be arranged to avoid simultaneous heating and cooling.
8. All panels and terminal devices are to be permanently identified as per Facility Services Subgroup - General requirements for Mechanical Identification.
9. Controls are to be started up, commissioned and fully adjusted prior to functional performance testing by DPW or their representative.
10. The mechanical design engineer is to coordinate with the electrical design engineer the line voltage wiring of control panels and the placement of 120V receptacles within a reasonable distance (approximately 10 feet) of DDC panels for powering PCs or laptops.
11. The mechanical design engineer is to ensure sensor well installation is coordinated with the piping specification.

12. The mechanical design engineer shall ensure that line voltage wiring for control devices such as freeze-stats, humidifier air flow cutouts, etc. is designated to be by the appropriate sections of Divisions 21-28 Arrange with the electrical engineer for all starters to be provided with necessary relays, and auxiliary relays to permit central indication of alarm conditions. The mechanical design engineer shall specify the control configuration for the 'hand' and 'auto' modes on the HVAC motor starters.
13. The control specification shall include all control wiring, and also interfacing between the main control system and the specialized terminal controls for equipment such as variable speed drives and humidifiers. Refer to electrical Division 26 for wiring and electrical equipment installation requirements. Note: All control wiring shall be Yellow.
14. Warranty
15. Warrant all controls equipment, parts and labour against defects and workmanship for one (1) year.
16. Service & Preventative Maintenance
  - 16.1. Service and preventative maintenance routines shall be performed by factory trained technicians and tradesmen a minimum of four times per year during the warranty period. During this period, components of the system are to be inspected and serviced. Reports shall be submitted to DPW indicating the items checked and service work performed, and the condition of the equipment following each inspection. A minimum of 33% of all control panel hardware, control software, points, sensors, valves, thermostats, dampers, actuators, controllers, relays, transducers, equipment interfaces, etc. on the system shall be inspected on each trip. The contractor shall consult with the Owner's maintenance supervisor on each trip regarding the performance of the system and address any deficiencies that have occurred.
17. Maintainability and Reliability
  - 17.1. The equipment shall be designed in such a way that the time necessary for any repair or maintenance will be reduced to a minimum. All modules, components and test jacks shall be easily accessible.
  - 17.2. Maintenance of any satellite panels or any peripheral device shall not affect the remainder of system.
  - 17.3. Means must be provided for monitoring and locating component and system failures as quickly and easily.
  - 17.4. The system shall be designed so that damage caused by the failure of one element or component of the system will be limited to the element or component which has failed.

**Section 25 05 02      BAS: Submittals**

1. Operational and Maintenance Manuals
  - 1.1. Manuals shall be consistent with requirements of Division 01 and shall include: manufacturer's installation, operating and maintenance instructions; shop drawings including layouts and schematics (mechanical and electrical) showing location of key components; point description lists and verification point lists signed off by controls contractor and software printouts and; name of spare part suppliers and their addresses for each piece of apparatus or system supplied.
2. Personnel Training
  - 2.1. Provide practical training for up to four personnel designated by the Owner. Such training shall review manuals and available shop drawings. Emphasize how each control system is interfaced with the HVAC systems. Also cover control sequences, alarms, operators commands, operator overrides, listing point values, listing trend values, all non DDC controls and troubleshooting of common problems.
  - 2.2. A minimum period of six hours shall be provided initially for on site training. A second six-hour follow-up session shall be provided up to two months later. An additional ten hours of telephone consultation shall be provided for addressing operator questions during the first year of operation.

## Section 25 05 53 Identification for Integrated Automation

1. Manufacturers Nameplates
  - 1.1. Each piece of equipment shall have a metal nameplate mechanically fastened to equipment with raised or recessed letters. Nameplates to be located so that they are easily read. Do not insulate or paint over plates.
  - 1.2. Include registration plates (e.g. pressure vessel, Underwriters' Laboratories and CSA approval) as required by respective agency and as specified. The supplier shall indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.
2. System Nameplates
  - 2.1. Major equipment to be identified with laminated plastic plates with white face and black center (lettering) of minimum size 89mm x 102mm x 2mm (3½" x 1½" x 3/32") nominal thickness, engraved with 13mm (½") high lettering.
  - 2.2. Nameplates to be fastened securely with pop rivets or screws in conspicuous place. Where nameplates cannot be mounted, such as on cool surfaces, provide standoffs.
  - 2.3. Unique mechanical identification tag shall follow naming system laid out on drawings and in specifications. Equipment type, number and service or areas or zone of building it serves to be identified.
3. Equipment Concealed by Ceiling
  - 3.1. At valves, control dampers air vents and drains, and other similar pieces of mechanical equipment located above T-bar ceilings or access doors, install circular 19mm (¾") diameter self-adhesive identification discs on the underside of the ceiling, as close as possible to the location of the equipment.
  - 3.2. Discs shall be coloured as scheduled in this section (see pipe primary and secondary colours table).
  - 3.3. Where the item has a primary and secondary colour, provide a 19mm (¾") diameter primary colour disc with a 9.5mm (3/8") diameter secondary colour disc centered on the primary disc.
4. Electrical and Controls Equipment Identification.
  - 4.1. Electrically fed equipment supplied by Division 21-28 (excluding that noted in .2 and .3, below) shall be identified as per Division 26 identification requirements.

- 4.2. Intermediate and end control devices including sensor, controllers, monitoring devices etc. shall be identified with laminated plastic plates or white polyolefin tags as noted for system nameplates above. The plates shall be fastened securely with pop rivets or screws. Where rivets or screws are not feasible, provide heavy duty plastic tie wraps. As a minimum, control device identification shall correspond to descriptors provided in the approved shop drawings with respect to panel designation or DDC point name.
- 4.3. Control devices located concealed by ceilings shall also be provided with a second identical plate installed on the underside of the ceiling grid or access door opening frame, as close as possible to the location of the device.

**Section 25 10 02      BAS: Operator Work Station (OWS)**

1. Facility Management Software

- 1.1. The DDC system shall be provided with standard and custom report generation functions that include:
  - 1.1.1. Alarm Summaries
  - 1.1.2. Motor Status Summaries
  - 1.1.3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
  - 1.1.4. Program Listings
  - 1.1.5. Runtime logs
- 1.2. All reports shall be either displayed or printed by:
  - 1.2.1. Operator Request
  - 1.2.2. Time or Date
  - 1.2.3. Event conditions (such as response to an alarm interlock, etc.)
- 1.3. All reports shall be time and date stamped.
- 1.4. An alarm processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed or printed at designated terminals.
- 1.5. Historical trend data shall be collected and stored at each DDCP or global supervisory network controller for later retrieval. Retrieval may be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection; either by a pre-defined time interval sample or by a pre-defined change of value. Trend data shall be presented in a columnar format. Each sample shall be time stamped. Trend reports may be single point or may be a group of points up to a maximum of 8 points in any single group. Any point, regardless of physical location in the system, may become part of a multiple point group. The system shall be capable of storing a minimum of 1000 values in each trend log.
- 1.6. Each DDC network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.



- 1.7. A database and configuration report program shall be provided that allows the user to interrogate DDCP status. As a minimum the user shall be able to verify available RAM at each DDCP, verify DDCP status (on-line, off-line failed) and set the system clock. Any invalid operator entry shall result in an error message.
  - 1.8. DDCP's shall contain a password access routine that will assign an operator to one of at least three levels of access. As a minimum, Level 1 shall permit display function only, Level 2 shall additionally permit commanding of system points and Level 3 shall additionally permit full program and database editing.
  - 1.9. DDCP's shall provide for the accumulation of totalized values for the purposes of run- time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.
2. Energy Management Software
    - 2.1. A Duty Cycle Control program shall provide user definable variable "on" and "off" times throughout the day once the mechanical or electric equipment is started by Time Program Commands, Optimum Start, or Manual Command.
    - 2.2. The time of the overall cycle, as well as the length of time for each load during the cycle, shall be user selectable. Off time for different loads can be staggered within the cycle period and temperature compensation may be programmed to reduce the off portion of the cycle, as required.
    - 2.3. The operator shall be able to read program data or to reprogram the system. Any of the program parameters, such as cycle time, off time, adding or deleting loads, auto adjust sensor assignments, input of compensation, etc., may be monitored or altered by a qualified operator through a connected operator terminal. A qualified operator shall be able to temporarily override the status or value of any point.
    - 2.4. The DDC system shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user in English language to specify month, year, day, time and associated point commands.
    - 2.5. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time delays shall be provided to "stagger" on times. TOD shall incorporate a holiday and special day schedule capability which will automatically bring up a pre- defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance. In addition to the time dependent two state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time

of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops, controlled by the DDCP. As with the two-state control, time dependent setpoint control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal. The operator shall be capable of reading and/or alternating all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule. The TOD program shall interface with the Optimal Start Program (OSP) such that stop times may be assigned by OSP.

2.6. In addition to the previously specified management functions, the DDC system shall be provided complete with the following programs:

2.6.1. Supply Air Reset

2.6.2. Hot Water Reset

2.6.3. Dead Band Control

2.7. All specified energy management programs, whether or not applicable shall be provided such that the programs may be enabled at a future date without the need to purchase or modify additional software.

### 3. Point Expansion Modules

3.1. Each DDCP shall be capable of extending its input/output capabilities via special purpose modules. Said modules may be mounted remote from the DDCP and shall communicate with the DDCP over a pair of twisted cables.

### 4. Graphic Display

4.1. System information (including all point values and status) shall be displayed dynamically in both text and graphics. Graphic displays shall utilize picture files of floor plans, elevations, system schematics, control panels, text, scanned images, etc. as background layers. The foreground layer shall contain real time data such as point values, time, set points, as well as control buttons. Data shall be placed on each graphic display and easily moved to its appropriate location. Graphic displays shall support minimum 16 bit colour and must be fully customizable to suit the users specific requirements. From the graphic display, the user shall monitor data, make changes as required and access other resources such as trend graphs and schedules directly by using the mouse.

5. On-Site Operator's Workstation.
  - 5.1. Provide a report and alarm printer adjacent to the video display terminal. Printer shall be an ink jet or laser printer. Provide one spare printer cartridge for each type the printer uses.
  - 5.2. The printer shall be interfaced to the operator workstation PC through a parallel or USB port and shall be supplied with all required cables and devices.
  - 5.3. A personal computer (with monitor) or tablet computer shall be provided which shall be fully capable of running the controls software, be able to store trendlog data, and be able to connect to the internet and network. The computer or tablet shall be secured in the room in which it is located.
  - 5.4. For limited DDC applications where printers and computers are not required (as determined by consultation with DPW), a display on the DDC panel shall be provided (where feasible) for programming and monitoring. As a minimum, a port shall be provided (complete with any required connectors and software for interfacing with a PC) for set-up and service.

**Section 25 30 01      BAS: Building Controllers**

1. Control Panels

1.1. Control panels shall be the steel unitized cabinet type with hinged door. Construct panels from 12-gauge furniture steel with baked enamel finish on exterior and rust inhibitive paint on interior. Panels shall have hinged key lock for full access. All controllers, thermometers, or temperature indicators, relays, switches, etc. shall be panel mounted. Control panels shall be provided for all air system and water system controls. One panel may accommodate more than one system in the same equipment room. Mount panels adjacent to their associated equipment on vibration free walls or on the closest column. Mount plastic enclosed, reduced size shop drawings of all systems in the cabinet or on an adjacent wall. Provide engraved plastic nameplates indicating panel identification and all instruments and controls inside the cabinet and on the cabinet face.

2. Pneumatic Piping for existing pneumatically controlled buildings

2.1. Copper pipe shall be hard drawn control instrumentation copper tubing. Plastic pipe shall be rodent resistant PVC, type FR. All piping shall be run in a neat and workmanlike manner parallel to surfaces and supported from the structure. Pipe shall be sized in accordance with manufacturer's recommendations to handle the required air quantities. Piping shall be adequately supported. Soldered fittings shall be used on copper piping, except at valves, remote bulb controllers and at panel connections, where compression fittings shall be used. Copper pipe shall be used where tubing is run exposed, in all mechanical rooms and where subject to damage. Seal all openings between pipe and pipe sleeves. Plastic tube shall not be supported and/or hung from horizontal piping and/or conduits. Maximum spacing of supports on concrete structure shall be 61 cm (2"). Supports shall be anchored to concrete, adhesive stickers are not acceptable. Copper tubing shall be supported on maximum 183cm (6") centers.

3. Direct Digital Control (DDC) Systems

3.1. The following DDC sections are applicable to educational facilities, hospitals and generally buildings over 20,000 square feet. For other buildings and also renovation projects, consult with DPW on DDC design requirements and scope for specifying a more limited small scale DDC to suit the application. The need for features such as memory, graphics, trending, front-end hardware, remote access, etc. shall be closely examined, keeping in mind the cost, and benefits to be gained from using these features. Consult with DPW regarding the requirements for BACnet features, building IT network interface, web based access to DDC system and communication or integration with other building systems (e.g. fire, security, etc.). See later items in this section for additional requirements related to these issues.

- 3.2. The DDC system shall consist of an information sharing network (control LAN) of stand-alone Direct Digital Control Panels (DDCPs) to monitor and control equipment per the control sequence and the input/output summary. A DDCP may include directly connected point expansion modules. Global supervisory network control panels on the control LAN may be acceptable provided the control design requirements are met. All DDC field devices related to the following items shall be connected to highest level DDCPs (i.e. DDC terminal device controllers at the highest level of the control LAN architecture): air handling units, pumps, outdoor sensors, hydronic sensors, 1st priority alarms, boilers, chillers, mixing valves, critical space conditions, fans for controlling space temperature in critical location, humidifiers, variable speed drives, and other critical components. The highest level DDCPs and any global supervisory network controllers shall be individually connected to a common network. All points associated with each mechanical system shall be connected to the same DDCP (e.g. all DDC sensors, controls, relays, etc. associated with a specific air handler shall be connected to the same DDCP).
- 3.3. All Freeze, Fire, High limited and Low Limited alarms to be provided with DPDT electrical contacts or auxiliary relays to permit central indication of alarm conditions.
- 3.4. Additional temperature sensing wells, pressure taps and flow measuring sensors to be provided to allow for the addition of central monitoring sensors.
- 3.5. Ensure correct sensor is installed to match well.
- 3.6. Control System Communications Processing
  - 3.6.1. All DDC control panels in a facility shall be connected to form a fully operational information sharing local communications network (control LAN). In smaller facilities with only one DDC control panel, the DDC panel system shall be capable of network operation with no additional upgrade. The DDC functions and point data resident on any DDCP plus any external point data required for control by that panel shall be operator accessible by connecting and logging on to the panel with a typical personal or laptop computer with a minimum of Windows 7 operating system. Include in the DDC system architecture a fully functional telephone modem (not required if remote access is by internet/intranet) and a personal computer / operator workstation package connected to a highest level controller or to the highest level of the control LAN.
  - 3.6.2. The communication speed between the highest level DDCPs on the control network shall be more than sufficient to efficiently pass full information sharing of all DDC point values, panel status, memory transfers and operational functions.

- 3.6.3. The failure of any DDCP on the network shall not affect the operation of other DDCPs. A DDCP failure shall be annunciated at the specified alarm printers or terminals. In the case where a failed DDCP is generating a global value, the remaining DDCPs shall continue using the last valid global value received from the failed panel.
- 3.6.4. In the event of a loss of communication with, or failure of a processing unit, the controlled equipment/system shall be left in a fail-safe mode.
- 3.7. DDCP Hardware
  - 3.7.1. Each DDCP shall consist of a minimum 32-bit programmable microprocessor and controller, power supply, real time clock, input/output boards and communication board. All program and point data bases shall be stored in battery-backed or non-volatile on-board memory. Provide a minimum of 256K RAM or an equivalent combination of RAM, ROM and EEPROM in each DDCP, sufficient to support all of the control, alarm, equipment schedules and communication functions specified and to allow for point expansion. Additional battery backed or non-volatile memory shall be provided as needed for supervisory, communication and trend data storage functions configured as needed on the control LAN.
  - 3.7.2. All DDCPs shall have a personal computer interface port in addition to network ports. Connecting a PC to this interface port shall allow the user to communicate with and program any controller on the network. Memory contents of the DDCPs shall be transferable to and from the PC via this port.
  - 3.7.3. Supply and install the hardware (and software) required so that at least one of the highest level standalone DDCPs is BACnet/IP ready and complete with a BACnet communications port ready for a connection to third party BACnet devices.
  - 3.7.4. Each DDCP shall provide for input/output connections to field equipment. The following point types shall be supported:
    - 3.7.4.1. Analog Inputs: for measuring sensed variable. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
    - 3.7.4.2. Analog Outputs: For controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pneumatic pressure signals. Pneumatic outputs shall be provided with a manual override for adjusting outputs in the event of power loss at the DDCP.

- 3.7.4.3. Digital Inputs: for monitoring dry contacts such as relays, switches, pulses, etc.
- 3.7.4.4. Digital Outputs: To control two position devices such as starters, actuators, relays, etc.
- 3.7.5. DDCPs shall have a minimum of 10 percent spare capacity within each mechanical room for future point connection. The type of spares shall be in the same proportion as the implemented points in the DDCPs. In any case there shall be no less spares than two analogue inputs, two digital inputs, two analogue outputs and two digital outputs in each mechanical room and no less than one spare point of each type in any DDCP.
- 3.8. Programming Functions
  - 3.8.1. Resident software in each DDCP shall provide for custom programming of control strategies, point database, operator interface, network communications, facilities and energy management functions. Use of a global supervisory network control panel for certain non-critical communications and facilities management functions may be acceptable.
  - 3.8.2. Programming of control and energy management strategies shall be accomplished via a high-level computer language. A standard math processor shall be part of the programming language. All analog control loops shall be capable of proportional (P), integral (I), and derivative (D) control in the form of P, PI or PID control with programmable loop constants.
  - 3.8.3. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command and edit the DDCP via a self prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Full access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCPs in order to display or command system points.

**Section 25 30 02      BAS: Field Devices**

1. Space Control
  - 1.1. Spaces subject to different loads must have separate controls. Each room requiring space control shall have an individual space sensor. Only one sensor may be installed in any room unless it is considered that there are separate zones within the room. A zone with separate heating and cooling units must have the units sequentially controlled from a single sensor.
2. Hot Water Space Heating
  - 2.1. Supply water temperature for general space heating shall be reset according to outside air temperature. Setpoints shall be predetermined by the design engineer.
3. Circulating Pump Control
  - 3.1. The sequencing of heating pumps shall take into account load requirements, automatic back-up and run time equalization, however, it is assumed that all heating will be shut down when the ambient temperature rises above 18 deg. C (65 deg. F) and will not restart until the ambient temperature drops below 16 deg. C (60 deg. F). Circulation through the boilers must be maintained while the boilers are on-line by either primary circulators or bypass circulators. See also Heating Design Considerations in Facility Services Subgroup - General and related Section 23 52 00 - Boilers for additional information related to thermal shock prevention.
4. Actuators
  - 4.1. Provide spring returns so that the damper's fail-safe mode is normally open or closed, as dictated by freeze, fire or over-temperature protection. Size operators to control dampers against the maximum fan pressure or dynamic closing pressure, whichever is greater, with sufficient reserve power to provide smooth modulating action or two position action as specified. For pneumatic actuators, pilot positioners shall be full relay type with an interconnecting linkage to provide mechanical feedback on mechanical damper operators and valves. Provide pilot positioners where more than two controlled components are sequenced, select spring ranges suitable for the control sequence specified.
5. Control Valves
  - 5.1. Provide valves pressure-rated in accordance with general valve pressure ratings specified elsewhere.
  - 5.2. 2-way water valves shall have equal percentage characteristics for typical hot water applications and linear characteristics for chilled water or steam applications.



- 5.3. 3-way water valves shall have linear characteristics.
- 5.4. All valves shall have stainless steel stems and spring loaded, self-adjusting Teflon or rubber packing. Except for sequenced valves, all valves shall have full range springs. Sequencing of coil valves shall be by positive sequencing relays to ensure no overlap of operation. Valves 51mm (2") and under shall be screwed, valves above 51mm (2") shall be flanged. Valve operators shall be sized to close the valves against the shut-off head of the associated pumps.
- 5.5. Size hydronic control valves for radiators and coils at 65% of the pressure drop between the supply and return, at design conditions.
- 5.6. Size hydronic 3-way mixing valves for the boiler bypass at a pressure drop equal to the design pressure drop from the bypass connection through the boiler to the 3-way valve inlet.
- 5.7. Pneumatically actuated 3-way valves shall have pilot positioners.
6. Supply Air Temperature Control
  - 6.1. Air systems supplying air to a multiple room zone shall be controlled from a supply air sensor with its set point varied according to a schedule with outdoor temperature. Additional reset based on return air, exhaust air or room air temperatures shall be provided where overheating or underheating may occur, within maximum and minimum supply air temperature limits.
  - 6.2. Operate mixing dampers, preheat, heat recovery, heating coils and cooling coils in sequence to maintain supply air set point.
  - 6.3. DX cooling coils shall be staged based on space or return air temperature.
7. Outside Air Mixing
  - 7.1. Dampers shall be selected as indicated under "Dampers" and "Mixing Dampers". An adjustable minimum position control shall be provided on all fresh air dampers. Exhaust air and return air dampers may be modulated together from a common activating signal. Outside air damper control shall be from a separate signal. For systems with cooling, economizer control based on enthalpy control. The mixing dampers shall be controlled in sequence with heating and cooling to maintain supply air set point.
  - 7.2. The normal mixed air damper control shall be overridden to maintain mixed air temperature at an adjustable minimum set point.
8. Dampers
  - 8.1. Blades shall not exceed 15cm (6") wide or 122cm (4'-0") long. Modular maximum size is 122cm (4'-0") x 122cm (4'-0"). Multiple sections shall have stiffening mullions and jack shafts. Frames and blades shall be extruded aluminum. Bearings shall be oilite or nylon with 13mm (½") shafts. Linkage and shafts shall be zinc plated steel. Vertical shafts shall have thrust

bearings. Dampers shall have compressible seals and shall be suitable for temperature ranges of -40 deg. C (-40 deg. F) to 93 deg. C (200 deg. F). Local (shop) fabrication of dampers is not allowed. Dampers mixing cold and warm air shall be parallel blade mounted at right angles to each other with the blades opening to mix the air streams. Make allowance in damper sizing to equalize the pressure losses through the airstreams. All shut-off dampers in outside air intakes and exhaust air outlets shall be insulated low leakage type with synthetic rubber seals on all blade edges and sides of frame.

#### 9. Damper Sizing

- 9.1. Minimum size 15cm high x 30cm (6" high x 12") long with 15cm (6") increments up to 122cm x 122cm (48" x 48"). Use multiple section dampers for larger sizes.
- 9.2. The free air ratio of the damper, i.e. total open area of the damper between blades divided by the nominal area shall be approximately 0.7.
- 9.3. The resultant damper size may be smaller than the duct size. The blanking pieces required shall be the responsibility of the sheet metal contractor.

#### 10. Mixing Dampers

- 10.1. The mechanical design engineer designer is to be responsible for the sizing of the outside air and return air dampers. This shall not be left to the equipment manufacturer. All dampers mixing cold and warm air shall be parallel blade with blades opening to mix the air streams. The mixing box must be arranged to give air mixing with fresh air drawn in horizontally and return air drawn in vertically, or vice versa. Make allowances in damper sizing to equalize the pressure losses through the entire fresh air intake and return air systems. Also provide blenders to promote mixing.

#### 11. Face and Bypass Dampers

- 11.1. Use parallel blade dampers throughout.
- 11.2. Size bypass damper so that bypass system pressure loss is equal to the face damper and coil section loss. Where extreme temperature differences are encountered between air streams, coil face and bypass selections shall be multiple sections with each bypass not wider than 15cm (6"). For packaged equipment, check sizes and resistance to ensure that bypass resistance of open bypass damper is equal to coil and open face damper, by inserting plate after bypass to increase bypass exit velocity.

#### 12. Variable Volume Dampers

- 12.1. Size dampers so that their operating characteristics are linear with respect to their associated system.
- 12.2. Where centrifugal prime mover is not controlled to maintain constant damper pressure loss, size dampers for equal percentage characteristics.

### 13. Glycol Preheat Coils

- 13.1. Preheat coils should normally not be needed as the air system coils shall be protected by glycol. For the exceptions where they are used, full flow of the heating media in the preheat coil must be provided when the air entering the coil falls below 4 deg. C (40 deg. F). Where face and bypass control is used, dampers to be designed for complete mixing so that air below 4 deg. C (40 deg. F) does not strike any part of a freezable upstream coil. When the full heating media flow on a face and bypass damper coil may result in overheating when the entering air temperature is above 4 deg. C (40 deg. F), an additional modulating control valve must be provided.

### 14. Reheat Coils

- 14.1. Sequence reheat according to individual space requirements. All reheat coil valves shall close when the fan stops.

### 15. Cooling Coils

- 15.1. The recommended control for constant flow chilled water systems is mixing or bypass valves. In the case of variable flow chilled water systems having individual chiller pumps, or variable speed primary pumps with a common or decoupled piping configuration, use coil pumps, 2-way valves and mixing valves as needed for adequate control. Sequence chillers and secondary (i.e. system) flow to maintain optimum system pressure differential and chilled water supply temperature.
- 15.2. Cooling coils on individual supply air systems shall be controlled in sequence with mixed air dampers and main heating coils.

### 16. Humidity Control

- 16.1. Humidifier control shall be based on return air or space humidity with a provision for high limit supply air humidity override. On a demand for humidification, the control element shall modulate the humidifier. All humidifying valves to close or humidifier to shutdown when the fan stops.

### 17. Multizone Unit Control

- 17.1. Zone thermostat calling for most heat to control the hot deck coil. The preheat coil and mixing dampers are to be sequenced to follow the cold deck controls. The cold deck coil valve shall not open until the preheat coil is off and the preheat coil shall not come on until the outside air damper is in minimum position. In all cases, ensure that precooling and reheating, or vice versa, is not possible. Where reheat coils are used, the zone thermostat calling for the coolest air shall control the main system, where economically feasible. Where reheat coils are located remotely, the central system shall be controlled from its discharge air at a fixed set point as a completely independent system. Where zone loads are similar, the hot deck leaving temperature may be reset from outside temperature to reduce reheat.

## 18. Variable Volume Systems

18.1. To conserve horsepower and limit noise, the system static pressure shall preferably be controlled by a fan speed control or variable inlet vanes. For fan systems without volume regulators on terminal units, sensors shall be located near the static pressure midpoint of the duct run. Where volume regulators are installed, pressure controllers may be located at the end of the duct run with the highest static pressure loss. Separate controllers shall be used if a major variation in flow and pressure occurs in different zones with changes in load. High static limits are recommended at the fan discharge. Multiple point pitot tubes or flow measuring stations shall be used for sensing velocity pressures at supply and return fans on variable volume systems.

## 19. Freeze Protection for Air Systems

19.1. Outside air dampers must close completely when supply fan stops. Dampers are to be the low leakage type. Each coil bank is to be protected by a low limit control which responds to the lowest temperatures to which any one square foot portion is subjected. The low limit control shall shutdown the supply fan when temperatures less than 3 deg. C (38 deg. F) are sensed. In exceptional cases where an air supply has no heating coil, low limit controls should be provided as necessary to protect equipment downstream of the air handler. When an air supply system is shut down, control must be provided to bring on the heating coil if abnormally cold temperature are sensed in the air system.

## 20. Thermostats

20.1. Room thermostats shall be fully proportional with an adjustable throttling range not exceeding 30 deg. C (86 deg. F) with two dial stop pins to limit setpoint range. Thermostats shall be single or dual temperature direct or indirect acting as required. All thermostats shall be provided with bi-metallic dial thermometers. Thermostats to be mounted in accordance with barrier free requirements of the Nova Scotia Building Code Regulations Act.

### 20.2. Electric Thermostats

20.2.1. Shall be line voltage or low voltage type suitable for the application. Low voltage thermostats shall have heat anticipation. Ratings shall be adequate for the applied load. Guards shall be installed over adjustable thermostats in public areas.

## 21. Temperature Sensors

21.1. All master space temperature sensors and other space temperature indicating sensors shall be of the linear output type, with an appropriate range and blank stainless steel locking covers. Room return air sensors shall be of the linear output type with bi-metal sensing element and corrosion proof construction with an appropriate range. Seal opening to wall cavity. Vandal proof screws shall be used in public areas. Private areas shall have setpoint

adjustment by user. Setpoint adjustment shall be limited to a 3 deg. C (37 deg. F) range.

22. Duct Mounted or Immersion Sensors

22.1. Averaging element sensors shall have a minimum 274 cm (9'-0") element. Temperature sensors shall be of rigid stem construction using bi-metallic sensing elements except where averaging is required. Duct mounted sensors shall be located to provide sensed temperature of maximum reliability as well as maximum possible ease of accessibility. Outside air temperature sensors shall be located on a north facing wall or shall be provided with an appropriate sun shield.

23. Low Limit Controllers and Safety Cutouts

23.1. Shall have elements providing adequate coverage of cross sectional area with control at the coolest point (6m (20') elements are normally preferred).

23.2. Safety low limits shall be line voltage type with bellows activated switches. Reset shall be manual or automatic to suit the application.

23.3. Freeze stats shall be located immediately after the heating coil. The element shall be constructed of rigid copper tubing arranged in a grid covering the complete face of the coil and shall be securely mounted to the coil.

24. Safety High Limit

24.1. Shall be manual reset, line voltage type with bi-metal actuated switches.

24.2. Switch shall have an adequate rating for the applied load.

25. Status Indicators

25.1. Provide status lights at motor starters.

25.2. With DDC controls, provide status indication for fans over 150 cfm, either by pressure differential switches or current sensors (set to detect fan belt breakage). Status is not required for recycle room fans which run continuously, assistive care washroom fans, range hood exhaust fans and laundry exhaust fans.

25.3. With DDC controls, provide status indication for pumps over 1/5 hp using current sensors (set/programmed to signal impeller problem, coupling failure or cavitation where possible). Status is not required for domestic hot water recirculation pumps.

25.4. Coordinate with electrical discipline for necessary current sensors, relays, and auxiliary relays to permit central indication of alarm conditions. All current sensors, relays etc. for motor starters and motor control centres shall be factory installed with all components and assemblies CSA approved; field installation shall not be permitted. Refer also to Division 26 requirements.

26. Heating/Cooling System Changeover

26.1. System to be provided with safeties to prevent chilled water from being diverted to boiler and to prevent water hotter than 27 deg. C (80 deg. F). from being diverted to chiller.

27. Temperature Sensors (DDC)

27.1. Temperature sensors shall be thermistor or RTD type with the following characteristics where applicable:

27.1.1. RTD's shall be 3 wire platinum type having a resistance of 100 ohms at 177 deg. C (350 deg. F) with low strain construction and integrally anchored lead wires.

27.1.2. Sensing elements shall be sealed from moisture intrusion.

27.1.3. Sensors (as shipped) shall have fast response to temperature changes (i.e. less than 5 seconds to indicate  $\pm$  -14 deg. C (6 deg. F) of a sudden -7 deg. C (20 deg. F) temperature change.

27.1.4. Sensors shall have a nearly linear resistance temperature relationship over the rated temperature range.

27.1.5. The rated sensor accuracy measured in accordance with a recognized standard shall be at least  $\pm$  -17 deg. C (1.5 deg. F) from -46 deg. C (-50 deg. F) to 49 deg. C (+120 deg. F) for outdoor sensors;  $\pm$  1 deg. C (1.8 deg. F) from -1 deg. C (30 deg. F) to 104 deg. C (220 deg. F) for immersion sensors,  $\pm$  0.7 deg. C (1.3 deg. F) from -1 deg. C (30 deg. F) to 32 deg. C (90 deg. F) for duct sensors and  $\pm$  0.4 deg. C (0.7 deg. F) from 16 deg. C (60 deg. F) to 27 deg. C (80 deg. F) for space sensors.

27.1.6. Mixed air sensors shall be averaging type with an element length at least four times the cross section length of the mixed air plenum.

27.1.7. Duct sensors shall have stainless steel stems which extend into air flow by at least one third of the maximum duct width or diameter to a maximum of 46cm (18").

27.1.8. Immersion sensors shall have stainless steel stem with matching thermowells suitably sized for piping. Fill well with heat conducting compound when installing sensor.

28. Humidity Sensors (DDC)

28.1. Measuring Range: 0 to 100% RH

28.2. Accuracy at +20 deg. C (68 deg. F): +/-2% RH for 0-90% range. Temperature coefficient: +/- 0.05%RH/degree F and +/-0.018 degrees F/ degrees F. Stability better than +/-1% RH/year.

28.3. Polymer capacitive sensor for RH.

28.4. Outside Air

28.4.1. Non-corroding shield designed to minimize solar and wind effects.

29. Airflow Pressure Switches (DDC)

29.1. Pressure sensing elements to be Bourdon tube, bellows or diaphragm type, with adjustable setpoint and differential.

29.2. Operate automatically and reset automatically when condition returns to normal.

30. Damper End Switches (DDC)

30.1. Activated by damper blade movement and mounted securely on damper frame.

30.2. Rotary action steel slotted lever with plastic roller.

30.3. Two electrically isolated single pole changeover micro switches.

30.4. Contact rating of 10 amperes at 120 V AC.

30.5. CSA approved and bearing a ULC label.

31. Differential Pressure Switches (DDC)

31.1. Adjustable set point with range to match application.

31.2. SPDT contacts.

31.3. CSA approved.

31.4. Mount with diaphragms in a vertical plane.

32. Current Sensors (DDC)

32.1. Sensors must be certified to the applicable CSA standard.

32.2. Analog current sensors are preferred over current switches that provide on/off digital signal.

32.3. As noted in the Canadian Electrical Code, current sensors shall not be installed in motor control centres unless provided by manufacturer. Refer also to Division 26 requirements.

32.4. Refer to Division 26 for specifications related to the installation of alternating current transformers.

**Section 25 30 03      BAS: Installation**

1. Telecommunication Capabilities

- 1.1. A telecommunications interface shall be furnished as necessary to allow direct connection of DDCP's and networks to public and private phone lines. This device shall be capable of both automatic answer and automatic dial methods of call handling. Additionally, manual call initiation shall be done via a man-machine interface command. The unit shall be able to store a minimum five (5) phone numbers of at least 20 digits and shall support communications at speeds of greater than 9600 baud (bits per second). Where a high-speed communication line will serve the building, provide remote access and IT network interface similar to that noted below for educational facilities. Consult with DPW on specific requirements.
- 1.2. As a result of a predefined event or command, the telecommunications interface shall automatically establish communications with specific PCs/workstations, mobile telephones or pagers. Consult with DPW and, for educational facilities, school board maintenance personnel for specific requirements.
- 1.3. The telecommunications interface shall have automatic answer capabilities to allow it to be accessed remotely. The interface unit shall be able to allow the person calling access to any information on the network, provided that the standard log-on security screening is met.

2. Telephone Connection

- 2.1. A telephone line shall be provided to allow remote access to the DDC system for a period of one year from substantial completion of controls work. This is not required if remote access is by a high speed communication line.

3. DDC Point Requirements

- 3.1. DDC systems shall be designed with all the necessary input/output devices including, but not necessarily limited to the following:
  - 3.1.1. Air Handlers (recirculation type with no heat recovery)
    - 3.1.1.1. Outside air temperature (if not already provided for heating systems)
    - 3.1.1.2. Return air temperature
    - 3.1.1.3. Mixed air temperature
    - 3.1.1.4. Supply air temperature
    - 3.1.1.5. Return air humidity (where applicable)
    - 3.1.1.6. Supply air humidity (where applicable)
    - 3.1.1.7. Return fan start/stop



- 3.1.1.8. Supply fan start/stop
- 3.1.1.9. Return fan status
- 3.1.1.10. Supply fan status
- 3.1.1.11. Exhaust/return damper modulation
- 3.1.1.12. Outside air damper modulation
- 3.1.1.13. Freeze-stat status
- 3.1.1.14. Heating coil valve modulation
- 3.1.1.15. Cooling coil valve modulation
- 3.1.1.16. Humidifier modulation or staging (where applicable)
- 3.1.1.17. Remote override signal (e.g. to allow users to activate gym or kitchen/cafeteria ventilation)
- 3.1.1.18. Air Handlers (100% outside air type with heat recovery)
- 3.1.1.19. Outside air temperature (if not already provided for heating systems)
- 3.1.1.20. Return air temperature
- 3.1.1.21. Exhaust air temperature
- 3.1.1.22. Heat recovery discharge temperature
- 3.1.1.23. Supply air temperature
- 3.1.1.24. Return air humidity (where applicable)
- 3.1.1.25. Supply air humidity (where applicable)
- 3.1.1.26. Return (exhaust) fan start/stop
- 3.1.1.27. Supply fan start/stop
- 3.1.1.28. Return (exhaust) fan status
- 3.1.1.29. Supply fan status
- 3.1.1.30. Exhaust damper open/close
- 3.1.1.31. Outside air damper open/close
- 3.1.1.32. Exhaust damper end switch
- 3.1.1.33. Outside air damper end switch
- 3.1.1.34. Freeze-stat status
- 3.1.1.35. Heat recovery modulation (if not integral)
- 3.1.1.36. Heat wheel start/stop (where applicable)
- 3.1.1.37. Heat Wheel modulation or staging (where applicable)

- 3.1.1.38. Heat Wheel Status
- 3.1.1.39. Heat recovery coil glycol entering temperature (if run-around type)
- 3.1.1.40. Heat recovery coil glycol leaving temperature (if run-around type)
- 3.1.1.41. Heating coil valve modulation
- 3.1.1.42. Cooling coil valve modulation
- 3.1.1.43. Humidifier modulation or staging (where applicable)
- 3.1.1.44. Remote override signal (e.g. to allow users to activate gym or kitchen/cafeteria ventilation)
- 3.1.2. Variable Frequency Fan Drives
  - 3.1.2.1. VFD status
  - 3.1.2.2. VFD control
  - 3.1.2.3. Static air pressure in applicable duct
  - 3.1.2.4. Differential pressure in applicable piping system
- 3.1.3. Ventilation Exhaust Fans
  - 3.1.3.1. Fan start/stop and status requires for fans greater than 150 CFM. Start/stop is not required for recycle room fans which run continuously, range hood and dishwasher exhaust fans. Exhaust systems over 250 CFM shall be complete with motorized backdraft dampers except for recycle room fans which run continuously, range hood exhaust fans and where not permitted by code. All motorized backdraft dampers shall be c/w end switches which must be made before the exhaust fan operates.
- 3.1.4. Exhaust/Supply Fans for Space Cooling
  - 3.1.4.1. Control fan(s) and dampers by electric cooling thermostat or by DDC. For rooms with fuel fired appliances (eg. boiler rooms), DDC control shall be provided. If DDC, then provide start/stop, status and room temperature points. Exhaust/supply systems over 250 CFM shall be complete with motorized backdraft dampers with end switches which must be made before the fans operate. For rooms with fuel fired appliances (e.g. boiler rooms) provide control so that a fan cannot operated without proof that the other fan is operating properly.
  - 3.1.4.2. If DDC, then provide start/stop, status and room temperature points

- 3.1.5. Pumps/circulators (including hydronic, fuel, DHW heating).
  - 3.1.5.1. Pump start/stop and status (for pumps over 1/4 hp and over).
- 3.1.6. Humidifiers
  - 3.1.6.1. DDC points as indicated under air handlers
  - 3.1.6.2. Separate direct wired air flow proving switch to be provided
- 3.1.7. Room Heating
  - 3.1.7.1. Room temperature
  - 3.1.7.2. Heating control valve
- 3.1.8. Unit Heaters and Cabinet Heaters
  - 3.1.8.1. Typically control by local thermostat
  - 3.1.8.2. If DDC, then provide space temperature sensor and fan start/stop
- 3.1.9. Boilers
  - 3.1.9.1. Header supply temperature
  - 3.1.9.2. Burner enable/disable
  - 3.1.9.3. Burner status (by current sensors)
  - 3.1.9.4. Primary and shunt (bypass) circulation pumps status
  - 3.1.9.5. Alarms
- 3.1.10. Secondary Hot Water or Hot Glycol Loops
  - 3.1.10.1. Outside air temperature (on north wall or complete with shade to shield from direct sunlight when installed on exposures other than north)
  - 3.1.10.2. Supply temperature
  - 3.1.10.3. Return water temperature
  - 3.1.10.4. Control valve modulation
- 3.1.11. Glycol Heat Exchange Coil
  - 3.1.11.1. Leaving temperature on output side
  - 3.1.11.2. Inlet temperature on output side
- 3.1.12. Domestic Hot Water (indirect type)
  - 3.1.12.1. Provide DDC or aqua-stat temperature control for each tank

3.1.12.2. If DDC, then provide immersion temperature sensor for each tank

3.1.13. Trap Primer: Solenoid valve(s) on/off

3.1.14. Water Meter(s): Pulse input with controls programming to provide daily total flow and daily peak flow.

#### 4. DDC Alarms

4.1. The DDC system shall be designed to provide the operator with all critical alarms. Suitable time delays are to be programmed to screen momentary false alarms. DDC alarms are to include but not necessarily be limited to the following:

4.1.1. Failure of any control panel

4.1.2. Failure of any fan linked to the DDC

4.1.3. Failure of any pump linked to the DDC

4.1.4. Failure of any heat wheel

4.1.5. Low pneumatic air pressure

4.1.6. Low boiler header temperature (if outside air temperature is less than 7 deg. C (45 deg. F))

4.1.7. Low room temperature (if any room on outside wall is less than 10 deg. C (50 deg. F))

4.1.8. High room temperature (if electrical, boiler, or communications room is greater than 31 deg. C (88 deg. F))

4.1.9. Air handler freeze-stat low limit status when activated

4.1.10. Supply air humidity greater than 80%

4.1.11. VFD failure

4.1.12. Low supply air temperature (if less than 8 deg. C (46 deg. F))

4.1.13. Boiler alarm.

#### 5. Interlocks

5.1. The DDC system shall be designed and programmed with all applicable control interlocks required to maintain reasonable air balance, protect equipment and prevent unnecessary discomfort. The interlocks shall not allow short cycling of equipment. The interlocks shall include but not necessarily be limited to the following:

5.1.1. Supply and exhaust fans are to stay off until both dampers open (for 100% outside air type AHU)

5.1.2. Shutdown humidifier, exhaust and outside air dampers with air handler

- 5.1.3. Shutdown heat wheel or heat recovery pump with air handler
- 5.1.4. Shutdown AHU heating pump except to maintain low limit temperature
- 5.1.5. Schedule major ventilation exhaust fans with respective air handler
- 5.1.6. Shutdown Chemistry Lab general exhaust if fume hood exhaust turned on.
- 5.1.7. Shutdown Lab Storage/Prep Room general exhaust if fume hood exhaust turned on
- 5.1.8. Shutdown air handler supply and return fans on low supply air temperature
- 5.1.9. Shutdown humidifier on fan or supply humidity alarm until fan restarted
- 5.1.10. Shutdown supply and return fans on any air handler if either fan alarms
- 5.1.11. Start back-up pump when lead pump remains in alarm otherwise stop back-up.
- 5.1.12. Shutdown boiler if shunt (bypass) circulation pump alarms.
- 5.1.13. Enable backup boiler if header temperature in alarm (stop if alarm acknowledged)
- 5.1.14. Alternate lead boiler and pump assignments at appropriate intervals
- 5.1.15. Reset heat recovery control to prevent frost formation
- 5.1.16. Interlock DDC pump and fan control via 'auto' mode of HOA switches
- 5.1.17. Bypass switch to be provided for burner DDC start/ stop relay
- 5.1.18. Adjust cafeteria/kitchen AHU return/exhaust air according to range hood exhaust status

**END**

## DIVISION 26 - ELECTRICAL

### Section 26 00 00 Electrical General Requirements

#### 1. Design Basis:

- 1.1. Varying, or deviating from any item(s) indicated in this document must be approved by the Minister's Representative. The Minister's Representative will not grant a deviation from these requirements unless the deviation has been submitted in writing for review and approved prior to proceeding with the design.
- 1.2. Base the electrical design on providing the following features:
  - 1.2.1. Safety to personnel during operation and maintenance of equipment.
  - 1.2.2. Optimum performance of electrical systems.
  - 1.2.3. Compatibility with other design elements.
  - 1.2.4. Ease of maintenance of equipment to be maintained by non-specialized personnel.
  - 1.2.5. Flexibility of electrical services.
  - 1.2.6. Proper coordination of all elements of the system as per the following:
    - 1.2.6.1. Insulation Levels.
    - 1.2.6.2. Interrupting Capacities - Provide the interrupting capacity on a single line diagram required for all equipment fed from each bus based upon a calculated fault level and indicate as per the following examples: 10 kAIC, 18 kAIC, etc.
    - 1.2.6.3. Protective Relaying.
    - 1.2.6.4. Mechanical Strength.
    - 1.2.6.5. Hazardous Location Classification.
    - 1.2.6.6. Allowance for future growth and expansion.
    - 1.2.6.7. Compliance with all governing standards and codes - In no instance shall the minimum standards established by this document be reduced by the application of any other codes.
    - 1.2.6.8. Perform In order to confirm code compliance and to provide a record for OH&S purposes that safety to personnel during operation and maintenance of equipment has been

considered during electrical system design; the designer shall provide a coordination study to justify selection of fuses and breakers. Perform the coordination study on the electrical distribution system, using the available site utility information such as Grid MVA, X/R ratio, fault current and voltage obtained from electrical utility. This study shall indicate the available fault current levels at each major distribution component. All overcurrent devices are to be properly coordinated. Where the distribution system is existing, the coordination study need only be performed on the portions of the system being modified. Provide a copy of this study no later than with the 80% complete document review submission, the submitted coordination study is to be stamped / signed by a professional engineer licensed to practice in the Province of Nova Scotia.

### 1.3. Arc Flash Hazard Analysis

1.3.1. In order to provide a record for OH&S purposes that safety to personnel during the operation and maintenance of electrical equipment has been taken into consideration during the system design; the designer shall carry out an Arc Flash Hazard Analysis during design in accordance with CSA Z462 and IEEE Std 1584, in conjunction with the short circuit and protective device coordination studies to justify selection of fuses and breakers. The study will include fault current momentary duty and protective device clearing times and will define the flash protection boundary and the incident energy at any position or level in the electrical distribution system where work could be performed on the energized parts. Where the downstream electrical equipment cannot be deenergized for maintenance or the available incident energy level is deemed to be excessive, the use of arc flash mitigating / reducing maintenance switch(s) is to be considered during the design of the distribution system. If the distribution system is existing, the analysis need only be performed on the portions of the system being modified. Provide a copy of this study no later than with the 80% complete document review submission.

1.3.2. The study will provide the following for each circuit condition and location analyzed:

1.3.2.1. Arcing fault magnitude

1.3.2.2. Device clearing time

1.3.2.3. Duration of arc

- 1.3.2.4. Arc flash boundary
- 1.3.2.5. Working distance
- 1.3.2.6. Incident energy
- 1.3.2.7. CSA Z462 compliant warning label listing incident energy, arc flash boundary, and hazard risk category.
- 1.3.3. Provide and install appropriate warning labels to each piece of distribution equipment identified in the Arc Flash Hazard Analysis. Labels are to include information in conformance with CSA Z462, including but not limited to:
  - 1.3.3.1. Available incident energy level.
  - 1.3.3.2. The arc flash boundary distance.
  - 1.3.3.3. Voltage of equipment
  - 1.3.3.4. Minimum glove class.
- 1.3.4. Provide and install appropriate warning labels to each piece of distribution equipment identified in the Arc Flash Hazard Analysis. Labels are to include information in conformance with NFPA 70E, including but not limited to:
  - 1.3.4.1. The severity of the arc flash hazard
  - 1.3.4.2. The distances involved
- 1.4. Thermographic Assessment - Electrical Systems
  - 1.4.1. Provide a Thermographic Assessment on Electrical Systems where the electrical service is rated 600V and 600A or larger. Where electrical systems are rated less than 600V and 600A, a thermographic assessment need not be provided unless this distribution system contains ACM feeders, provide a Thermographic Assessment on the ACM conductor terminations only in these systems.
  - 1.4.2. Thermographic assessment of the building electrical distribution system shall include but not be limited to:
    - 1.4.2.1. Service entrance equipment,
    - 1.4.2.2. Main switchboard,
    - 1.4.2.3. Distribution panels,
    - 1.4.2.4. Panelboards,
    - 1.4.2.5. Disconnect switches,



- 1.4.2.6. Transformers,
- 1.4.2.7. Motor Control Centres, etc.
- 1.4.3. This work is to be performed after the complete installation of the electrical distribution and the system equipment is operating and under normal load conditions. The report shall contain an analysis of electrical equipment, termination and components using thermal imaging equipment to observe thermal anomalies providing specific information indicating localized, abnormally warm or cool connections that could indicate potential problems.
- 1.4.4. Thermographic Inspection Report shall be an organized document stating the description of components being inspected, general findings, and any recommendations including, but not limited to appropriately analyzed thermal images with corresponding visual photographs to express observed conditions, with statements interpreting observed deficient conditions. Recommendations identify complete with recommended corrective measures to fix deficient conditions.
  - 1.4.4.1. Report to include as a minimum the following information for each item of equipment:
    - 1.4.4.1.1. Description of component being inspected.
    - 1.4.4.1.2. Colour photograph of component.
    - 1.4.4.1.3. IR photograph of component.
    - 1.4.4.1.4. Voltage, amperage rating and phase of component.
    - 1.4.4.1.5. Exact location of component.
    - 1.4.4.1.6. Date and time of inspection.
    - 1.4.4.1.7. Surface temperature of component being inspected.
    - 1.4.4.1.8. Actual load condition on electrical equipment.
    - 1.4.4.1.9. Abnormal physical conditions based on visual inspection.
    - 1.4.4.1.10. Difference in temperature between inspected component and defined reference component / ambient air temperature.
    - 1.4.4.1.11. Provide Identification and Diagnoses of any suspected problems including photographs and
    - 1.4.4.1.12. Commentary indicating severity and types of thermal anomalies detected.

- 1.4.4.1.13. Provide Interpretation of observed conditions and suspected deficiencies including probable causes of the thermal anomaly(s) detected.
    - 1.4.4.1.14. Personnel Performing thermographic scans shall be certified in accordance with ASNT SNT-TC-1A
  - 1.4.4.2. Include the Thermographic Assessment report in the O&M manuals for the facility
- 1.5. Provide a riser diagram for each system (including a power distribution single line diagram) on the drawings. All items are to be grouped by floor level. Risers are not to contain electrical floor plan layouts with or without the architectural floor plan in the background. Show ALL system components in this riser. Where the design is provided for a renovation, partial riser diagrams for the affected portions of these systems are acceptable.
- 1.6. All exterior lighting is to be shown on the electrical site plan.
- 1.7. Exit signs and emergency lighting layouts shall be shown on the same drawings as the fire alarm layouts so as to keep the electrical life safety systems on the same drawings, where practical. If these systems are not able to be shown on the same floor plan, provide a separate floor plan for each system.
- 1.8. Provide match lines for all partial floor plans.
- 1.9. Building Renovation and Upgrade Projects:
  - 1.9.1. Existing electrical condition and demolition drawings shall be based on thorough site investigations of existing devices / equipment for all systems within the project scope. Existing condition / demolition drawings for each system shall indicate the source for all equipment and devices within the project scope. Existing condition / demolition drawings shall indicate all electrical power sources complete with circuit identification (where possible) and source power panel locations for those devices and equipment being reused, removed or relocated.
  - 1.9.2. All Telecommunication outlets to be removed or relocated shall also be included on existing condition / demolition drawings; additionally, include in their identification information on the drawing and the Telecommunication room feeding them.
  - 1.9.3. In case site information is absent, inaccessible or uncertain, the consultant shall seek guidance from the Ministers representative first, and facility personnel if directed to do so by the Ministers representative, The consultant may also refer to record drawings (if

available) to assist them in making reasonable assumptions. Clearly indicate in the documents where the contractor will undertake specific, additional site review to determine actual site conditions.

2. Overhead Electrical Service:
  - 2.1. Refer to Section 33 71 00.1 - Overhead Electrical Service
3. Underground Electrical Service:
  - 3.1. Refer to Section 33 71 00.2 - Underground Electrical Service
4. Security System:
  - 4.1. Refer to Division 28 for Security System.
5. Lighting Control Equipment - Low Voltage:
  - 5.1. Refer to Section 26 09 24 - Instrumentation and Control for Electrical Systems
6. Fire Alarm System:
  - 6.1. Refer to Section 28 31 00 - Fire Detection and Alarm.
7. Electric Heat:
  - 7.1. Refer to Section 23 80 00 - Decentralized HVAC Equipment.
8. General:
  - 8.1. Extend wiring to, and connect all wiring for motors, control equipment and other electrical or mechanical equipment indicated on the working drawings. Do not include low voltage control wiring 50 volts and less. The mechanical consultant will provide a list of mechanical equipment requiring electrical wiring to the electrical consultant. The electrical consultant is to incorporate this information in a mechanical equipment schedule on an electrical drawing. All mechanical equipment wiring, except that under 50V for controls, shall be installed by a certified electrician.
  - 8.2. Extend wiring to, and connect all equipment furnished by the building owner.
  - 8.3. Electrical equipment located in areas where corrosive materials may be used shall be suitable for that particular type of application.
  - 8.4. Fire barrier materials are to be used when penetrations are made through fire rated walls, floors or ceilings. These materials are to be applied in strict accordance with manufacturer's instructions.
  - 8.5. Provide concrete housekeeping pads for all free-standing electrical equipment, i.e. switchboards, motor control centres, dry type transformers, generators, transfer switches, etc. Pads are to be a minimum of 150mm (6") larger than outside dimensions of equipment they support, not less than 100mm (4") thick, and be complete with chamfered edges.

- 8.6. Locate fans, electrical or mechanical fixtures, and/or other types of wall mounted building appendages, not less than 3660mm (12') above finished grade to bottom of units.
- 8.7. In new construction, all light switches are to be a maximum of 1220mm (48") A.F.F.
- 8.8. In new construction, all power/voice/data/CATV/multimedia outlets are to be a minimum of 450mm (18") A.F.F.
- 8.9. All free-standing switchboards and/or motor control centres rated 600 Amps and "larger," and located on ground floors or slabs-on-grade, shall be c/w concrete encased "troughs" located directly beneath same as follows:
  - 8.9.1. Unless specifically indicated otherwise, concrete troughs are to be extended under all combined sections making up main switchboard, with the exception of that portion of board containing "main overcurrent" breaker/fuses and metering sections.
  - 8.9.2. Underground PVC rigid (feeder) conduit(s) installed between exterior padmount transformer/overhead poles, are to be extended a minimum of not less than 50mm (2") up through housekeeping pad below section of board containing said overcurrent protection, and have non-flared type "bell-ends" installed.
  - 8.9.3. Unless specifically indicated otherwise, concrete troughs are to be extended under all combined sections making up a motor control centre(s).
  - 8.9.4. Ends, sides and bottom to be of concrete construction and not less than 510mm (20") in total depth from underside of floor slab to inside bottom of trough.
  - 8.9.5. Bell-end flare type fittings are to be used where terminations of underground rigid PVC conduits to sides or ends of concrete troughs takes place.
  - 8.9.6. Provide a minimum of two spare 63mm (2-1/2") PVC rigid conduits from "concrete trough" to nearest available clear wall space. Both 63mm (2-1/2") conduits are to terminate in shared or common 450mm high x 300mm wide x 150mm (18" high x 12" wide x 6") deep type "E" box, with transition from PVC to rigid threaded steel conduit to take place "below" finish concrete floor slab and transition from rigid steel conduit to EMT conduit taking place "above" concrete floor slab.

- 8.10. All designated “fire rated” walls and/or separations indicated on architectural drawings, are to also be identified (with bolded lines) on electrical life safety system floor plans.
- 8.11. Q-Deck Installation:
  - 8.11.1. Where metal type Q-Deck is being used, all cables/conduits are to be installed on room sides of upper portions of the Q-Deck (directly above tops of, and at right angles to steel joists) and secured directly to sides of metal flutes and/or structure.
  - 8.11.2. Where cables/conduits are installed in same direction as steel joists, they are also to be secured as high as possible to underside of metal decking and/or structural steel, with approved type supports intended for the particular application.
  - 8.11.3. Under no circumstances are cables/conduits to be laid in, fished in, or otherwise installed in top or upper (roof) sides of metal flutes. All wiring is to be surface installed on, or to, the underside of room structure.
  - 8.11.4. Where the Q-Deck forms part of the roof framework, and the conduits are installed in an enclosed ceiling area, the contractor has the option of installing the conduits on the underside of the uppermost angle iron support of the OWS Joist, with the use of an approved type support, intended for the particular application.
- 8.12. Provide conduit sleeves for conduit penetrations through floor assemblies. Terminate sleeves flush with floor assemblies except in mechanical rooms, where sleeves will terminate 50 mm (2 in.) above finished floor.
- 8.13. Where “tilt-up” construction is utilized, all outlets indicated in tender documents and addendums are to be installed flush. In existing installations where the wall has been poured, utilize aesthetic type surface raceway in finished areas and surface conduit/boxes in unfinished areas.
- 8.14. The chain hanging of lighting fixtures shall be limited to unfinished areas.
- 8.15. Firestopping
  - 8.15.1. Caulking should not be used as a method for firestopping PVC conduits.
  - 8.15.2. Firestopping listings/shop drawings should be reviewed by the engineer/consultant as part of the shop drawing process.
- 8.16. Open ceiling Concept:
  - 8.16.1. Where finished ceilings (T-bar, drywall, etc.) are not provided, please note that all exposed wiring shall be run in conduit/EMT.

- 8.17. All electrical equipment is to be installed as per manufacturer's recommendations.
  - 8.18. All electrical controls (thermostats, light switches, TOL switches, etc.) located in public areas are to have appropriate measures (keys, plastic guards, etc.) implemented to prevent unauthorized manipulation.
  - 8.19. Equipment shall not carry any logos or text which identifies the equipment manufacturer / supplier; exception: equipment located in service spaces.
9. Identification:
- 9.1. All switchboards, panels, disconnect switches, power/voice/data/CATV/multimedia outlets, MCC's, transformers, control panels, magnetic starters, TOL's, time clocks, are to be provided with "lamicoid" nameplates as further described herein. Care is to be taken to ensure that all plates are affixed true, level, and plumb in all instances.
  - 9.2. Where a lamicoid identified item is installed "within" ceiling spaces, two (2) lamicoid plates are to be provided - one at the item location and one on room side of T-Bar grid spline or access cover frames.
  - 9.3. Nameplates are to be affixed to all "metal" surfaces with metal type "pop-rivets."
  - 9.4. Nameplates are to be affixed to other types of surfaces with contact type cement.
  - 9.5. Nameplates are to be affixed to building "exterior" surfaces with nylon inserts and self tapping screws unless specifically indicated otherwise.
  - 9.6. Contact type cement is to be applied (buttered) to "complete" rear side of plate, as opposed to several points or locations on same.
    - 9.6.1. The use of water activated polyurethane glue is permissible in place of contact cement, however, ensure support for the lamicoid is provided during the curing cycle of the product. Excessive glue "squeeze out" or "product expansion" will necessitate replacement of the lamicoid.
  - 9.7. Lamicoid nameplates installed on switchboards, distribution panelboards, motor control centres, splitter troughs, transformers, shall indicate the following:
    - 9.7.1. Designated name of equipment.
    - 9.7.2. Amperage of overcurrent protection device.
    - 9.7.3. Voltages, number of phases and wires.
    - 9.7.4. Designation of power source.

**EXAMPLE**

**PANEL H -150 AMPS**

**120/208V - 3PH - 4W**

**FED FROM MAIN SWITCHBOARD # CDP-A**

- 9.8. Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, shall contain the following information:
- 9.8.1. Designated name of equipment.
  - 9.8.2. Designated name of power source.
  - 9.8.3. Branch circuit breaker number(s) where possible.
  - 9.8.4. Voltage(s) and number of phases.

**EXAMPLE:**

**EXHAUST FAN NO. 5**

**PANEL H - CCT. NO. 17**

**120V - 1 PH**

**EXAMPLE:**

**SUPPLY FAN NO. 3**

**M.C.C. NO. 1**

**600V - 3 PH**

- 9.9. Lamicoid nameplates installed on fusible type disconnect switches are to also indicate installed fusing and "maximum" fuse size.
- 9.10. Lamicoid nameplates are to be installed on all junction and/or pull boxes sized 6" x 6" and larger indicating name of system, designated panel name and electrical characteristics where applicable.
- 9.11. Lamicoid nameplates are to be installed adjacent to each overcurrent devices located in switchboards, CDP panels, MCC's, etc. They need only indicate designated name and/or number of equipment they feed. Each unused or spare overcurrent device is to be identified with a "Lamicoid" plate indicating "spare."
- 9.12. Lamicoid nameplates installed on "main" service entrance switches, or "main" entrance switchboards to indicate the following information on minimum size 15mm x 50mm (6" x 2") plate c/w two lines of 12.5mm (1/2") high lettering. (Size #8 nameplate)

**EXAMPLE:**

**MAIN BREAKER 800 AMPS**

**347/600V, 3PH, 4W**

**EXAMPLE:**

**MAIN SWITCH 200 AMPS**

**120/208V, 3PH, 4W**

- 9.13. Install an additional "Lamicoid" nameplate on all, or any piece of electrical equipment, or apparatus, i.e. Main Switchboard, CDP panels, Panelboards, Motor Control Centres, that may contain overcurrent devices, ie. circuit breakers and/or fuses, that have been designed for, and incorporate interrupting capacity sized "larger" than 10 kAIC.

**EXAMPLE:**

**Minimum interrupting capacity of breakers installed in this MCCpanel is to be not less than 22 kAIC**

**EXAMPLE:**

**Minimum interrupting capacity of fuses installed in this is to be not less than 100 kAIC**

- 9.14. Lamicoid nameplates are to be installed above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source c/w associated circuit breaker number(s) as per the following:

- 9.14.1. 1.6mm (1/16 ") thick x 12.7mm (1/2") high c/w 6mm (1/4") black letters on white face, directly above all flush receptacles (identical width as finish device plate for both single and double gang outlets):

**EXAMPLE: H – 20**

- 9.15. Receptacles intended for computer, electronic or other sensitive types of electronic equipment, are to be identified as per the following:

- 9.15.1. 1.6mm (1/16") thick x 19mm (3/4") wide c/w 6mm (1/4") black letters on white face above all flush receptacles (identical width as finish device plate for both single and double gang outlets):

**EXAMPLE: FOR COMPUTER USE ONLY**

**PANEL M – 20**



- 9.16. Lamicoid nameplates installed above 120-volt receptacles protected by GFCI circuit breakers, or GFCI type receptacles (where their use is permitted) are to be identified as per the following:

**EXAMPLE: GFCI PROTECTED PANEL M – 22**

- 9.17. Receptacles that are an integral part of systems furniture are not to be lamicoid identified. The power outlet feeding the systems furniture, however, is to be lamicoid identified similar to receptacles.
- 9.18. Provide lamicoid plates for all voice, data, microphone, and cable television outlets. Lamicoid nameplate(s) may be applied directly to face of finish plate where practical, c/w information as required.
- 9.19. All addressable fire alarm devices are to be lamicoid identified.
- 9.19.1. Lamicoid identification is to be chain hung as required on mechanical items (pressure switches, supervisory switches, etc.). A second lamicoid plate shall be installed for addressable interface modules provided for said mechanical items.
- 9.19.2. Manual pull station lamicoid plate to be installed similar to typical receptacle lamicoid plate.
- 9.19.3. Lamicoid wording to match physical location and annunciator display address.

**EXAMPLE: FLOW SWITCH - A - F - 2**

(MP = manual pull station) **EAST EXIT - MP – 15**

- 9.20. Allow for an “average” of 40 letters for each lamicoid nameplate.
- 9.20.1. Lamicoid 1/16 inch thick plastic engraving sheet, black core, white face, for all electrical systems except for the following:
- 9.20.2. Fire alarm and emergency power systems shall have red face with white core. (1/8" where secured to metals)
- 9.20.3. Power/voice/data/CATV/multimedia outlets shall have white face, black core.
- 9.20.4. 1.6mm (1/16") thick nameplates located less than 2400mm AFF shall have top left and right corners rounded off. where not applied to metals); exception: service rooms. Lettering on lamicoid nameplates shall not “start,” nor “end” nearer than 12.7mm (1/2") from either, or both ends of said plates. Size of lettering, including

overall lengths of various plates shall be as indicated in following chart:

### NAMEPLATE SIZES

Size 1 - 9.5mm x 50mm (3/8" x 2")	1 line - 4.8mm (3/16") high letters
Size 2 - 12.7mm x 76mm (1/2" x 3")	1 line - 6mm (1/4") high letters
Size 3 - 16mm x 75mm (5/8" x 3")	2 lines- 5mm (3/16") high letters
Size 4 - 19mm x 89mm (3/4" x 3.5")	1 line - 9.5mm (3/8") high letters
Size 5 - 38mm x 89mm (1.5" x 3.5")	2 lines 12.7mm (1/2") high letters
Size 6 - 25mm x 100mm (1" x 4")	1 line - 12.7mm (1/2)" high letters
Size 7 - 25mm x 100mm (1" x 4")	2 lines 6mm (1/4") high letters
Size 8 - 50mm x 100mm (2" x 6")	2 lines 12.7mm (1/2") high letters

- 9.21. Examples of "grouped" electrical equipment that could have identical types of removable covers, that will require their Lamicoid nameplates installed on wall(s) adjacent to control, rather than directly to their covers (this is to avoid the possibility of cover mix-up occurring): magnetic starters, magnetic contactors, manual T.O.L. switches, and relays.
- 9.22. Lamicoid nameplates for Time Clocks shall have the designated name(s) and location(s) of load(s) being fed, in addition to the following.
- 9.23. Voltages, Phases, Wires, Panel and circuit breaker number(s)

**EXAMPLE: PANEL HV - 3 PH/4 W - 347 V - LPA - Cct No. 16**

- 9.24. Lamicoid nameplates shall be provided and installed on, or adjacent to, all various systems' control panels and/or cabinets c/w information as indicated. Nameplates are to reflect individual system's assigned name, and where applicable, shall also indicate both, designated panel name and associated branch circuit breaker number(s).
- 9.24.1. Fire alarm panels
- 9.24.2. Security (intrusion) panels
- 9.24.3. Energy management panels
- 9.24.4. Public address panels
- 9.24.5. Television panels

- 9.24.6. Gymnasium sound panels
- 9.24.7. Communication panels
- 9.24.8. Low voltage lighting relay panels.

**EX A M P L E: LIGHTING RELAY PANEL #1 - LPA – 36**

- 9.25. Control Transformers:
  - 9.25.1. Concealed control transformers located within ceiling spaces are to have Lamicoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, c/w associated branch circuit breaker number(s).
  - 9.25.2. A second plate with identical information is to be installed on underside of room grid system or access opening frame directly below control transformer, so as to identify its concealed location directly above same.
  - 9.25.3. All control transformers installed in either control cabinets or on walls adjacent to same, are to be identified with Lamicoid nameplates containing information as previously indicated.
- 9.26. All various pieces of mechanical equipment are to be identified with “identical” information as indicated on electrical equipment Lamicoid nameplate feeding aforesaid mechanical equipment. Both “Lamicoid” nameplates are to be supplied and installed by the electrical contractor in the absence of any mechanical trade identification.
- 9.27. Bonding conductors require labelling on both ends of runs where they are “dedicated” solely to the designated branch circuit they accompany. Identify with same number(s) as being used to identify accompanying branch circuit phase(s) and neutral conductor(s).
- 9.28. Labelling of all branch circuit phase and neutral conductors is to be done on both ends of all circuit conductors, plus in “all” junction and/or pull boxes located in between. Use write-on, self laminating labels sized as necessary. To be installed in a “flagged” manner around individual conductor(s).
- 9.29. Coverplates for junction and/or pull boxes located above or within finish ceilings containing branch circuits, are to have each branch circuit number neatly identified on coverplate. Felt marker-pen may be used for this purpose.
- 9.30. All of the following conductors are to have their “insulation” colours identified as indicated:

<b>Phase</b>	<b>Red</b>
<b>Phase</b>	<b>Black</b>
<b>Phase</b>	<b>Blue</b>
<b>Neutral</b>	<b>White / Grey</b>
<b>Bond</b>	<b>Green</b>
<b>Ground</b>	<b>Green</b>
<b>Isolated Ground</b>	<b>Green c/w Yellow Stripe</b>

9.30.1. Colour coded "conductor insulation" as per the following:

9.30.1.1. All sizes of phase conductors up to and including #2 AWG.

9.30.1.2. All sizes of neutral, bond and/or ground conductors, up to and including #3/0 AWG.

9.30.2. Approved coloured tapes in lieu of insulation colouring may be used to identify conductors that exceed sizes as previously indicated. To take place on "both ends," of all runs, a minimum of 300mm (12") from where terminations take place, in addition to within all or any boxes located in-between both ends of runs.

9.31. All junction and/or pull boxes, conduit fittings (and respective covers), complete with their respective cover plates are to be colour coded as per the following: Boxes are to be coloured both inside and outside, where "one" colour only is required. Boxes are to be coloured on inside only where "two" colours are required. Metal coverplates are to have both colours applied diagonally where "two" colours are required. Complete plate is to be painted where one colour only is required. All junction boxes are to be colour identified prior to installation.

9.32. All various systems concealed junction and/or pull boxes located "within" ceiling spaces are to have their locations identified on room side of T-Bar grid spline or access cover frames with appropriate colour coded, circular shaped, self adhering discs. Discs are to be both,  $\frac{3}{4}$ " and  $\frac{1}{4}$ " in diameter as indicated in the following legend, with  $\frac{1}{4}$ " discs always being centered in middle of  $\frac{3}{4}$ " discs:

VARIOUS SYSTEMS	19mm (3/4") DISCS	6mm (1/4") DISCS
0 to 50 Volts	Violet	
51 to 240 Volts	Yellow	
241 to 600 Volts	Orange	
Fire Alarm	Red	9.33.
Telephone (voice only)	Black	
P.A. and Intercom	Blue	
Security	Brown	
Ground or Bond	Green	
Cable Television	Yellow	White
Nurse Call	Orange	White
Energy Management	Red	White
Computer (data only)	Black	White
Voice & Data	Blue	White
Other	Brown	White
Other		White
Other		White

- 9.34. Where boxes are not concealed, such as in an open ceiling concept, discs are to be fastened directly to the outside of the boxes after architectural painting is complete. Coverplates for boxes containing branch circuits, are to have each branch circuit number neatly identified on the inside of the coverplate. Felt marker-pen may be used for this purpose.
- 9.35. A legend of colour coding is to be provided under plexiglass and located in the main electrical room (600mm x 600mm (24" x 24") minimum size frame).
- 9.36. Where appropriate, coloured conduit may be used in lieu of colour coded boxes/fittings.

**Section 26 05 00 Common Work Results for Electrical**

1. Outlet Boxes, Conduit Boxes & Fittings

- 1.1. Sectional type boxes are not to be used without special permission from the Minister's Representative.
- 1.2. Cast type "FS" or "FD" boxes are to be utilized for all surface wiring of devices installed lower than 8' AFF, (regardless of systems type involved) c/w matching steel type "FS" metal device plates unless specifically indicated otherwise. Cover plates are to be specifically made for FS & FD boxes and are to utilize 4-point fastening.
- 1.3. Flush installed 100mm (4") square, or a 120mm (4-11/16") square box being used as a junction or pull box that requires a blank metal coverplate, is to have an appropriate sized, square welded one or two gang "tile ring" installed on same. This permits the use of a standard, one or two gang (blank) finish metal coverplate to be used, and avoids the necessity of acquiring an oversized, custom made coverplate.
- 1.4. When installing flush boxes in metal drywall partitions where the grouping of multiple device boxes is required, support the box between the studs with a box mounting bracket. Caddy RBS series box mounting brackets or Caddy SGB series box brackets or equal are approved for this application. Where a single flush box is installed, this box may be supported by the wall stud without any additional support required.
- 1.5. Condulet fittings (LB, LL, LR) and their respective covers/plates are to be painted, (coloured coded) and where concealed, have their locations identified with appropriate colour coded self adhering discs applied directly to T-Bar splines and/or access opening frames in same manner as required for identifying concealed junction and/or pull boxes.
- 1.6. The use of either, corner pulling "Ells" or corner pulling "Elbows" in lieu of acceptable "Condulet" fittings is strictly prohibited.
- 1.7. Tile type extension rings are not to be used on boxes that have not been "flush" installed. They are not intended, nor acceptable for "surface" type application.
- 1.8. Surface boxes intended to be used for housing 347-volt light switches are to be cast steel, type FS or FD, and "stamped" by manufacturer as being suitable for this particular voltage. Matching FS steel device plate is to also have 347 volts stamped into face of same. Where installed higher than 2440mm (8') AFF, metal type 1110-HV boxes c/w matching orange coloured metal switch plates may be used.

- 1.9. The use of floor boxes or PAC poles is to be approved by the Minister's Representative.
  - 1.10. Boxes connected to AC90 cables are to be specifically made for this purpose. Dual rated boxes (AC90/NMD90, etc.) are not acceptable.
  - 1.11. Outlet boxes mounted in tilt-up construction are to be properly placed and secured so that they are not accidentally dislodged prior to concrete pour. This is to include for both "face-down" and "face-up" design.
  - 1.12. Where devices are to be installed in t-bar ceilings, the devices shall be securely mounted by the following method: a 103mm (4") square box shall be supported by the grid system using a bar hanger, a single gang round or rectangular tile ring or other plate as required by the device, and sized accordingly, shall be mounted to the box flush to the underside (room interior) of the ceiling; mount the device to the tile ring or plate.
2. Conduits, Conduit Fastenings & Conduit Fittings
    - 2.1. Flexible Conduit:
      - 2.1.1. Liquid seal flexible conduit, not smaller than 12mm (3/8") inside diameter shall be used for final connections to "all" vibrating and/or mechanical equipment, including various systems' controls and related devices, sprinkler system devices, etc. only. The use of liquid seal flexible conduit as a general purpose raceway is not permitted.
      - 2.1.2. Steel type connectors are to be used on flexible type conduits. Malleable type connectors are not permitted.
    - 2.2. EMT Conduit:
      - 2.2.1. Unless noted otherwise, steel set screw type fittings shall be used on EMT. Rigid conduit fitting bodies made of alloys or malleable types of metals are not to be used.
      - 2.2.2. Screw-on metal (malleable) type bushings are to be installed on all EMT connectors sized 35mm (1-1/4") and larger. (To be installed prior to drawing-in conductors)
      - 2.2.3. EMT connectors sized 27mm (1") and smaller do not require insulated throats nor any types of "screw-on" type bushings.
      - 2.2.4. Rain-tight EMT connectors and couplings (complete with o-rings) are to be used on "vertical" portion of conduit runs, where terminating into tops of electrical equipment incorporating drip shields or hoods. This is a precaution or safeguard against possible

- infiltration of water into pieces of electrical equipment located in rooms containing sprinkler heads.
- 2.2.5. Vertically installed EMT conduit stubs from flush installed device boxes are to be provided in all block or concrete block walls.
  - 2.2.6. EMT conduit stub is to be off set out of wall into accessible ceiling space of room containing flush installed device box, and have steel EMT connector complete with plastic or grounding type bushings "screwed" on same. EMT plastic end cap bushings that are CSA approved may also be used.
  - 2.2.7. All EMT conduit "wall stubs" and associated boxes are to be adequately bonded to ground as per the latest edition CEC requirements.
  - 2.2.8. The use of EMT in wet and exterior locations is not permitted.
- 2.3. PVC Conduit:
- 2.3.1. Unless specifically indicated otherwise, all switchboards, distribution panelboards, motor control centres, splitter troughs, various systems control panels/cabinets, may be fed underground utilizing code approved, rigid type, thick wall PVC conduit.
  - 2.3.2. Conduits are only permitted to be installed below floors and are not permitted to be installed "in" concrete floor slabs unless specifically indicated otherwise. This is especially important when in-floor radiant heating is being utilized.
  - 2.3.3. PVC conduits sized 35mm (1-1/4") in diameter and larger are to be installed in trenches not less than 300mm (12") in depth from underside of concrete floor slab to bottom of trench. Conduits are to be placed on a 75mm (3") bed of freshwater sand and are to have a second 75mm (3") of freshwater sand placed on top. Conduits are to be "completely surrounded" by freshwater sand prior to backfilling taking place. This freshwater sand shall conform to either Medium or Fine grade particles as defined under ASTM D-2487 and D-2488.
  - 2.3.4. Conduit installation is not to influence the thickness of the floor slab.
  - 2.3.5. Conduits are not to be run along concrete walls installed to reinforce wall installations.
  - 2.3.6. Wiring for all various systems devices and/or outlets installed below ground floor concrete floor slabs may be performed utilizing code approved, minimum 21mm (3/4") PVC rigid type conduit. Transition from PVC rigid thick wall conduit to rigid steel threaded conduit to



- take place "below" floor slab. Transition from rigid steel threaded conduit to EMT type conduit to take place "above" concrete floor slab.
- 2.3.7. PVC conduits of all sizes prior to turning-up through floor slabs, unless specifically indicated otherwise, are to have transition to rigid steel threaded conduit take place as previously indicated.
  - 2.3.8. The installation of PVC type conduits above ground is prohibited.
  - 2.3.9. All conduits used in underground and tilt-up installations are to be up-sized at least one trade size above the minimum code requirement for ease of pulling.
  - 2.3.10. In tilt-up construction, utilize minimum 21mm (3/4") PVC conduit.
  - 2.3.11. Rigid Types EB1 and DB2/ES2 PVC (thinwall) Conduit (CSA C22.2 211.1) shall only be used where embedded in concrete.
  - 2.3.12. Rigid PVC (thickwall) Conduit (CSA C22.2 211.2) shall be permitted to be direct buried.
- 2.4. All various types of systems, including lighting and power, whose wiring is to be installed on any exposed types of surfaces are to always be completely installed in raceway as per the following guidelines:
- 2.4.1. Use EMT conduit in unfinished areas.
  - 2.4.2. Use aesthetic type surface raceway in finished areas where it is impossible to conceal conduits.
  - 2.4.3. Ceiling mounted conduit/raceway is to be secured directly to overhead structure and/or related structural steel as high as possible in the ceiling space, and as close as practicable to the underside of the deck.
  - 2.4.4. Wall mounted conduit/raceway is to be secured directly to, or directly on, exposed walls.
  - 2.4.5. AC-90 and/or other types of systems pliable cables are not to be installed on exposed walls and/or ceilings without the benefit of conduit/raceway. This applies to all systems, including control wiring.
- 2.5. The use of ENT shall not be permitted.
- 2.6. Control Circuit Raceway:
- 2.6.1. Mechanical controls raceway is to be similar to the voice/data structured cabling system.

3. Wire and Box Connectors - 0 - 1000 Volts

- 3.1. Use spring type pressure wire connectors for all branch circuit wiring sized #10 AWG and smaller. Current carrying parts are to be made of copper or copper alloy and be c/w an appropriate size insulating cap. Cap is to completely fit, or cover all enclosed conductors as required.
- 3.2. All wire connectors are to be "plier-tightened" (finger-tight is not acceptable).
- 3.3. Bushing stud connectors are not acceptable.

4. Service Equipment

- 4.1. Discuss well in advance with the Power Authority, the size and type of service required. Obtain from the Power Authority the three phase symmetrical short circuit fault level at their electrical service entrance transformer(s) to determine the interrupting capacity and coordination of protective devices required for the service equipment.
- 4.2. Primary Service Equipment: Include overcurrent protective devices, instrument transformers, metering equipment and other requirements of the Power Authority.
- 4.3. Allow for 100% lighting load plus an appropriate demand factor on the remaining load, based on operating characteristics.
- 4.4. The main service shall provide for minimum 25% load growth plus an allowance for future expansion if anticipated.
- 4.5. Submit a study of load requirements and obtain the Minister's Representatives approval before proceeding.
- 4.6. A 120/240 volt, single phase, three wire power source may be required to service specific items of equipment. Obtain the Minister's Representatives approval before proceeding.
- 4.7. A 120/208 volt, three-phase, four-wire system for lighting, receptacles and power is usually satisfactory for smaller buildings. For larger buildings, a 347/600 volt, three- phase, four-wire system or higher may be warranted. Obtain the Minister's Representatives approval before proceeding.
- 4.8. Incorporate H.R.C. Form I current limiting fuses into circuits requiring high short circuit protection.

**Section 26 05 19      Low Voltage Electrical Power Conductor and Cables**

1. Wiring for circuits exceeding 50 volts to ground shall be minimum size #12 AWG, soft drawn stranded copper, of 98% conductivity rated at (600 volts) unless specifically indicated otherwise.
2. Feeders fed from an overcurrent device rated up to and including 100A are to utilize copper conductors. Feeders fed from an overcurrent device rated above 100A may utilize aluminum conductor material (ACM). Ensure the use of a wire brush, joint compound, and proper torque wrench.
3. Bonding and grounding conductors shall always be copper.
4. Current carrying and neutral conductors for all systems rated 600 volts and less, shall have RW90 - XLPE type insulation rated accordingly.
  - 4.1. The supply and installation of 1000 volt rated conductors shall be considered only where equipment manufacturer or other applications warrants same.
  - 4.2. The neutral conductor on the secondary side of dry type transformers shall be upsized to 200%.
  - 4.3. The feeder neutral for all branch circuit panels which feed computerized equipment shall be upsized to 200%. Grounding and bonding conductors sized up to and including #10 AWG, are to have green coloured RW90 X-link insulation. Type TW75 c/w green coloured insulation is acceptable for all sizes #8 AWG and larger.
5. The tie-wrapping of the neutral conductor with its respective phase conductors is to be made at the closest point of entry "within" all panelboards, pull boxes, junction boxes, outlet boxes, etc.
6. All branch circuits which do not have neutral conductors, are to have their respective phase conductors tie-wrapped together in accordance with previously described methods.
7. Wiring methods related to the installation of main feeders:
  - 7.1. Where feasible, all feeder conductors to Main Switchboards, CDP panels, branch circuit panelboards, dry type transformers, MCCs, are to be fed under concrete floor slabs utilizing rigid (thick wall type only) PVC conduits.
  - 7.2. Unless specifically indicated otherwise, surface installed "feeder" conductors are to always be installed in EMT type conduits, run parallel and perpendicular to building lines.
8. The use of NMD-90 cable in new construction is prohibited; the use of NMD-90 in renovations must be pre-approved by the Minister's Representative. The Minister's Representative will not consider the use of NMD-90 in new construction, the use of

NMD-90 will only be considered if it exists in the building being renovated with prior approval, contact the Minister's Representative for this approval and details on the restricted use of this wiring.

9. Limited use of copper Teck, AC-90 or other types of armoured copper cables will be considered upon request:
  - 9.1. To be pre-approved by the Minister's Representative.
  - 9.2. In particular instances where the use of various types of rigid conduit might be considered impractical.
  - 9.3. Where environmental issues/conditions could dictate the use of other than rigid type of conduit installation use.
  - 9.4. All Teck cable is to be terminated with proper Teck connectors.
  - 9.5. All types of "armoured" cables are to be installed concealed, parallel and perpendicular to building lines and shall be adequately secured to the building structure at not less than 1525mm (60") intervals or as otherwise indicated, in such manner as to ensure they are protected from potential types of mechanical damage occurring. Install independent supports for cabling in ceiling spaces, and do not use those of other trades. Do not secure cables to mechanical systems piping, ducts, or suspended ceiling support wires. The laying of "un-supported" cables directly atop the ceiling grid system is strictly prohibited.
  - 9.6. Always install and secure surface cables directly to underside of metal decking and/or ceiling slabs where located in concealed ceiling spaces.
  - 9.7. AC-90 cable is to be installed as per the following guidelines:
    - 9.7.1. AC-90 shall only be permitted for branch circuit wiring drops from ceiling junction boxes to light fixtures, receptacles and other equipment in the same room requiring electrical power. The installation of AC-90 cable for branch circuit wiring home runs or runs between rooms is not acceptable. Conduit/wire shall be used for this purpose unless otherwise noted.
      - 9.7.1.1. All branch circuits are to utilize conduit pathways for home runs to each room or area, including rooms in which the panel is located. A home run is defined as that portion of the branch circuit wiring that runs between the applicable panelboard and the area or room in which it either terminates at the applicable branch circuit device or makes a splice for final connection to the applicable branch circuit device.
      - 9.7.1.2. Where the branch circuit has multiple splices and/ or drop offs to multiple rooms, the use of AC90 for the drop off is

permitted, however, the home run conduit shall be continued until the final room destination splice or drop off is reached.

- 9.7.2. The grouping together of AC-90 cables to form a “bundle” for securing purposes is acceptable providing the following procedures are adhered to:
- 9.7.2.1. In addition to securing type AC-90 cables at 60" intervals to structure, multiple or bundled groups of armoured cables shall be tye-wrapped together at mid-point between each structure support, or every 762mm (30") and are to be secured to structure at 1525mm (60") intervals, and also secured together (between each structure support) at 1525mm (60") intervals.
  - 9.7.2.2. In addition to the requirements of the Canadian Electrical Code, grouping of AC-90 cables shall be limited to a maximum of eight (8) current carrying conductors, including associated oversized neutral conductors where phase sharing occurs.
- 9.7.3. The following examples incorporate uses of both, common and dedicated (separate) branch circuit neutral conductors:
- 9.7.3.1. Maximum of two runs of #12/4 conductor cables, including common (oversized) branch circuit neutral in each.
  - 9.7.3.2. Maximum of two runs of #12/3 conductor cables, including (oversized) branch circuit neutrals (if not 3 phase, 3 wire), plus one run of #12/2 cable.
  - 9.7.3.3. Maximum of four runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.
- 9.7.4. Where dedicated or separate branch circuit neutral conductors are non phase sharing, they need not be sized larger than phase conductors they accompany unless specifically indicated otherwise.
- 9.7.5. All AC-90 fixture feeds shall originate from the sides of outlet boxes and not from the box cover. Where 3 and/or 4 fixture drops extend from any one outlet box, the box shall not be sized smaller than 120mm (4-11/16") square.
- 9.7.6. Fixture drop is defined as that portion of AC-90 cable or flexible conduit being used to make final connection between “accessible” type junction or outlet box located in ceiling space (above T-Bar ceiling only) and its respective light fixture.

- 9.7.6.1. Fixture drops are not to exceed 4570mm (15') in total length unless specifically indicated otherwise.
- 9.7.6.2. There shall be not more than 4 drops permitted to be fed from any one box regardless of its size. All AC-90 cables used for fixture drops are to be secured within 300mm (12") of the junction box. Each light fixture is to be complete with its own separate fixture drop originating from junction box located within same ceiling of room as fixture. An exception shall be recessed down lights which may be wired from one fixture to another if they have integral junction boxes and the luminaire access opening is 150mm (6") or greater in diameter.
- 9.7.6.3. With the exception of where "modular" type wiring has been "approved" for a particular application, within a T-Bar ceiling space, each light fixture shall be wired with a separate "whip" emanating from an overhead junction box.
- 9.7.6.4. Both, #12 AWG and #14 AWG type AC-90 armoured cables may be used where total fixture drop "loads" do not exceed the following:
  - 9.7.6.4.1. Maximum of 5000 watts @ 347 volts using #12 AWG drop.
  - 9.7.6.4.2. Maximum of 3500 watts @ 347 volts using #14 AWG drop.
  - 9.7.6.4.3. Maximum of 1800 watts @ 120 volts using #12 AWG drop.
  - 9.7.6.4.4. Maximum of 1300 watts @ 120 volts using #14 AWG drop
- 9.7.7. Separate pig-tail type leads shall be provided in each light fixture junction/outlet box for "final" connections to fixture drops. These pig-tail leads are to be "only" connected to light fixture "returns" and associated "neutral" conductors.
- 9.7.8. Termination of AC90 cable is to utilize steel connections with accompanying lock nuts similar to or equal to T&B 3301 series.
- 9.7.9. Vertically installed drops for all device boxes flush mounted in walls. Routing AC-90 cable horizontally through walls is not permitted except for short portions of the run where obstructions impede this method of installation, the remainder of the installation AC-90 cable

shall be vertically installed. Each device box requires its own dedicated vertical drop.

10. All cables are to be secured to concrete, concrete block, brick, metal decking/siding, with nylon type inserts c/w self tapping metal screws.
  - 10.1. Pliable type cables are to be secured to building structure at 4' intervals, and tie-wrapped together at mid-point between each structure support.
    - 10.1.1. Cables are to have insulation qualities as indicated.
11. Voltage drop in no instance shall exceed 3% of the line voltage. The following table is intended for all 120 volt, 15 amp branch circuits and is to include both vertical and horizontal lengths of conductor runs. Minimum size of branch circuit neutral where phase sharing occurs, shall not be smaller than #10 AWG. Minimum size of branch circuit neutral where dedicated to its own branch circuit phase conductor shall not be less than #12 AWG.

Branch Circuit Length of Run	Phase Wire Size	Separate Neutral	Common Neutral	Bond Wire Size
1' to 80'	#12	#12	<u>#10</u>	#14
81' to 125'	#10	#10	<u>#8</u>	#12
126' to 185'	#8	#8	<u>#6</u>	#10

12. The requirements for accommodating larger common or "shared" branch circuit neutral conductors where the application might warrant such, could restrict the use of some types of AC-90 cables. In certain instances, however, the installation of AC-90 cable" (where permissible), and the use of "oversized" neutral conductors where required, is more than acceptable.
13. Oversized #10 AWG branch circuit wiring conductors to be extended to outlet box of device they feed. Oversized #8 AWG branch circuit wiring conductors to be extended from panelboard to junction box located on wall or in ceiling space directly above outlet or device they feed. No. 8 AWG wire is to be reduced to #10 AWG for vertical portion of drop only.
14. All "stranded" conductors are to be "twisted together" prior to any types of terminations taking place, but not necessarily limited to, some of the following areas:
  - 14.1. Receptacles, Light switches, Neutral terminal strips, Bonding terminal strips, Circuit breakers, Disconnect switches, Magnetic and Manual starters, Magnetic contactors, Relays, All types of termination lugs, Panelboards, etc.

15. Control Circuit Wiring 50 Volts and Less:

- 15.1. Unless otherwise noted, mechanical controls wiring methods are to be similar to the voice/data structured cabling system, with the exception that cabling shall be run as high as possible.
- 15.2. The installation of "surface" wiring on walls or in open (non-enclosed) type ceilings, shall always be in EMT type conduit c/w associated "steel" type connectors and couplings.
- 15.3. EMT conduits are to be extended to within 762mm (30") of all various control devices associated with the operation of any given piece of mechanical equipment or device they might feed.
- 15.4. Unless specifically indicated otherwise, liquid tight flexible metal conduit c/w matching liquid tight type connectors are to be used for "final" connection between end of EMT conduit and applicable control device. A junction or pull box may also be utilized to make the transition.
- 15.5. EMT type conduit "wall-stub" turned out into the room where the device is located c/w flush installed device box shall be located in all partitions to accommodate wiring between the device and the underside of the metal decking in the accessible ceiling space.
- 15.6. EMT connectors c/w nylon insulated throat or threaded type bushing shall be installed on end of EMT stub where it protrudes through wall "above," and within finish accessible type ceilings. EMT plastic end cap bushings that are CSA approved may also be used.
- 15.7. All EMT conduit stubs are to be "bonded" to ground as required by the latest edition CEC.

16. Receptacles for computer use are to be wired as per the following:

- 16.1. Quadraplex type receptacle, or two (ganged together) 120V U-Ground duplex receptacles n grouped together in common (2) gang device box, are to be on the "same" branch circuit, maximum 3 workstations per circuit.
- 16.2. Provide "same size" branch circuit neutral conductor as accompanying phase conductor where neutral is separate or dedicated to same circuit.
- 16.3. Provide an "oversized" branch circuit neutral conductor where phase sharing with two or three other computer related branch circuits occurs.
- 16.4. Not more than 2 servers are to be fed from same branch circuit.
- 16.5. Each printer is to be fed from a dedicated branch circuit.
- 16.6. The location of receptacles and related communications outlets shall be coordinated with equipment layout and indicated accordingly on drawings.



17. Housekeeping receptacles located in corridors shall be grouped on separate dedicated 20A circuits, maximum 10m spacing.
18. All branch circuit phase and/or neutral conductors are to be "Megger" tested for insulation resistance utilizing the following type meter:
  - 18.1. 500 voltmeter for conductor insulations rated up to 500 volts.
  - 18.2. 1000 voltmeter for conductor insulations rated above 500 volts.
19. Conductor insulation rating
  - 19.1. Ensure that the insulation rating on branch circuits feeding all electrical loads comply with the latest edition of the CEC, and the manufacturer's recommendations.
  - 19.2. The minimum size of any branch circuit conductor used shall be based on the 75 degree C allowable ampacity in the CEC, with all relevant correction factors being applied as required. Transitions in conductor size due to the equipment's lower termination temperature rating and a higher insulation temperature rating used in the circuit shall not be permitted in the branch circuit wiring.

**Section 26 05 26      Grounding and Bonding for Electrical Systems**

1. Determine well in advance the type of grounding system (solid, high resistance, low resistance, ungrounded) to be used.
2. Determine well in advance with the equipment supplier as to any special grounding requirements. Keep a record of all correspondence with the suppliers, and forward same to the Minister's Representative upon request.
3. Indicate grounding details on drawings, especially for the incoming service and distribution transformers.
4. All grounding and bonding requirements shall be in accordance with all applicable C.E.C. codes and the DC350 standards, whichever is the most stringent.
5. All conduit for all electrical (including communications) systems is to contain a minimum # 14 AWG copper bond wire. Bonding jumpers are permitted for conduit stubbed into a T-bar ceiling. All metallic conduit stubs shall be bonded regardless of length.
6. For electrical services sized 200A and larger, install one predrilled minimum size 6mm x 100mm x 600mm (1/4" x 4" x 24") copper grounding bus bar, (either vertical or horizontal) on main electrical room wall unless specifically indicated otherwise, c/w approved cone shaped insulators for securing bus directly to same.
7. The main "incoming ground" conductor is to run unbroken to the main electrical service entrance overcurrent device ground bus and then to the wall mounted ground bus.
8. All other various systems' electrical ground connections (excluding transformer grounds) are to take place on the ground bus with "compression" type lugs. Lugs are to be as follows.
  - 8.1. Copper, one-hole, short barrel (single crimp) type lugs are to be used for all wire sizes up to, but not including #6 AWG.
  - 8.2. Copper, two holes, long barrel (dual crimp) type lugs are to be used for all wire sizes #6 AWG and larger.
  - 8.3. To be bolted to bus bar utilizing concave, or combination of flat and locking type washers c/w accompanying hardware as may be required.
9. All cables and feeder and branch circuit conductors installed in conduit are to be c/w a separate minimum size #14 (solid) AWG copper bond/ground wire as follows:
  - 9.1. Where bond wire sizes larger than #14 AWG are required, they are to be increased as required by C.E.C. table 16, or as otherwise noted.
  - 9.2. No.14 AWG and larger size ground or bond conductors shall be of soft drawn stranded copper of 98% conductivity, and of full size and AWG gauge.

- 9.3. Size of bond conductor is to be based upon the latest edition CEC.
- 9.4. Size of ground conductor is to be based upon the latest edition CEC.
- 9.5. Minimum size #14 AWG (solid) green insulated conductors are to be provided for bonding purposes associated with various other systems rated at 50 volts or less.
10. The contemplated use of any isolated ground systems and/or isolated ground type receptacles is to be approved by the Minister's Representative.
11. The "feed" bonding conductor shall be secured (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors, and/or providing a "pig-tail" lead for device terminations.
12. All bond wire joints are to be twisted together with a screw-on type wire connector, and then placed in rear of outlet box in such manner as to minimize obstructions.
13. Information transport systems bonding
  - 13.1. Provide an information transport system bonding riser on the drawings.
  - 13.2. Provide and install an information transport system bonding system to meet or exceed the requirements identified in the latest edition of the TIA 607 standard for Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
  - 13.3. Provide and install one predrilled minimum size 6mm x 100mm x 600mm (1/4" x 4" x 24") Primary Bonding Busbar (PBB) copper bonding bus bar in the main Telecommunications Entrance Facility, either vertically or horizontally wall mounted 450mm (18") A.F.F. c/w approved cone shaped insulators for securing bus directly to wall.
  - 13.4. Provide and install one predrilled minimum size 6mm x 100mm x 600mm (1/4" x 4" x 24") Secondary Bonding Busbar (SBB) copper bonding bus bar in each telecommunications room, either vertically or horizontally wall mounted 450mm (18") A.F.F. c/w approved cone shaped insulators for securing bus directly to wall.
  - 13.5. Bond each copper bonding bus bar to the building metallic structural framing where available.
  - 13.6. In each telecommunications room, bond all conductive equipment enclosures (including power panels) to the copper bonding bus bar.
  - 13.7. Bond each equipment rack individually to the room's copper bonding bus bar.
  - 13.8. The minimum size information transport systems bonding conductor shall be #6 AWG.

- 13.9. All Telecommunications Bonding Backbone (TBB) and Telecommunications Bonding Conductor (TBC) conductors shall be sized in accordance with the latest TIA 607 standard for Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises recommendations.
- 13.10. All Information transport systems bonding conductors are to be complete with green coloured insulation, the use of bare, stranded bonding conductors in cable tray is not permitted.
- 13.11. Information transport systems bonding conductors are to be run as directly as possible following building lines; minimizing the number of bends in the conductor and secured to meet the latest edition CEC requirements. The minimum bend radius of any information transport systems bonding conductor not run in conduit shall be 230mm (9”).
- 13.12. All bonding conductors exiting the telecommunications room, with the sole exception of the conductor used to bond the cable trays, shall be run in conduit. Ensure these conduits are bonded at both ends.
- 13.13. All conductor to conductor connections to the Telecommunications Bonding Backbone (TBB) and all other bonding conductors are to be made using irreversible, listed, compression connection; or by using an exothermic welded connection.
- 13.14. Bonding / Grounding conductor identification
  - 13.14.1. All bonding / grounding conductors shall be identified at both ends to indicate the bonded equipment (bond bar end) and the originating bond bus (equipment end of the bond conductor) using size 1 lamicaid nameplates secured to the conductor with two metal straps.
- 13.15. Ensure ALL antennae cables are routed through properly bonded RF protection device(s) at the antenna cable entry point to the building for lightning protection.

## Section 26 05 29 Hangers and Supports for Electrical System

1. Supporting of electrical systems raceway shall be independent of any non-electrical systems supports such as T-bar ceiling supports, mechanical systems supports, etc.
2. Various suspended types of outlet, pull and/or junction boxes including conduits, are to be supported with minimum size 9.5mm threaded rod, nuts and flat washers. Threaded rods are to be secured to boxes with one flat washer and nut installed on both sides of box.
  - 2.1. One rod required for all types of boxes sized 152.4mm x 152.4mm (6" x 6") or 23226 sq. millimeters and smaller.
  - 2.2. Two rods required for all types of boxes sized larger than 23226 sq. millimeters, up to, and including those sized 304.8mm x 304.8mm (12" x 12" ) or 92903 sq. millimeters equivalent.
  - 2.3. Minimum of four rods required for all boxes sized larger than 92903 sq. millimeters.
3. EMT shall be securely fastened in place within 1m (39") of each outlet box, junction box, pull box, cabinet or conduit fitting, with spacing between supports as per the C.E.C. Securing of surface and concealed conduits to structure for sizes up to and including 35mm (1-1/4") diameter may be done utilizing one hole steel straps. Two-hole steel straps for all sizes 41mm (1-1/2") and larger. Grouped or singularly suspended conduits of all sizes to be supported with minimum sized 9.5mm (3/8") threaded rods and concrete shields. Where possible, two or more suspended type conduits shall be secured to a common steel support channel system and are to be suspended utilizing minimum size 9.5mm (3/8") threaded rods, washers and nuts. Channel is to be sandwiched between nuts and washers located on both upper and underside portions of channels.
4. All excess rod is to be cut off within 12.7mm (1/2") of channel bottom. In addition to C.E.C minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300mm (12") from the midpoint of "all" 90 degree bends. Maximum spacings between conduit support channels shall be as dictated by smallest size conduit(s) being supported and/or secured to same.
5. The use of tie-wraps for "supporting" purposes, is strictly prohibited and will be strictly enforced. They may "only" be utilized to secure various systems wiring "in-place," for cable marshalling but in no instance are they to be used as a substitute for approved type metal straps, clamps, etc.

**Section 26 05 33 Raceways and Boxes for Electrical Systems**

1. All "surface" type boxes larger in size than 120mm (4") square where installed on, or within ceiling spaces, are to be type "E" c/w hinged type cover plates. Hinged covers are not required for pull boxes.
2. All "flush" installed boxes are to be type "D" and have their finish cover plates sized a minimum of 25.4mm (1") larger than actual box dimensions.
3. Concealed junction or outlet box (within ceiling space) feeding a "maximum" of (2) fixture drops, shall not be sized smaller than 100mm (4") square.
4. Single gang type device boxes being utilized in steel stud walls for the installation of both, metallic and (where approved) non metallic type cables, shall not be sized smaller than 246 cubic millilitres (15 cu in).
5. Two or more flush installed boxes ganged together, or boxes sized 100mm (4") square and larger (intended for devices), are to have an additional support bracket installed on opposite side of box not presently secured to metal stud.
6. Where larger sized devices or other types of "flush" outlet or junction boxes may be required, suitably sized 100mm (4"), 100mm (4") deep or 120mm (4-11/16") square boxes c/w appropriate sized extension tile rings are to be utilized. The use of "plaster" type extension rings in lieu of "tile" type extension rings is not acceptable.
7. Concealed boxes located in ceiling spaces above suspended type ceilings are not to be installed at greater than 762mm (30") above finished ceiling elevations. Where radiant heating panels are installed, junction boxes are to be "in-board" of same for easy access.
8. Junction boxes larger than 120mm (4-11/16") used in branch circuit wiring are to be c/w bonding terminal strips.
9. Pull boxes are to be bonded to ground utilizing a bonding conductor.

**Section 26 05 48      Vibration and Seismic Controls for Electrical Systems**

1. Where mandated by the National Building Code of Canada (NBCC), the Office of the Fire Marshal or as directed by the Ministers' Representative, provide Vibration and Seismic Controls for Electrical and Communications Systems to meet NBCC requirements.
  - 1.1. All components shall be ULC listed for use in seismic bracing and the control of vibrations.
  - 1.2. The final installation of the Vibration and Seismic Controls system shall be reviewed by a qualified engineer licensed to practice in the Province of Nova Scotia, and a letter of acceptance from this engineer of the Vibration and Seismic Controls installation shall be included in the O&M manuals.

## Section 26 08 00      Commissioning of Electrical Systems

### 1. Purpose

- 1.1. The basic purpose of electrical commissioning is to provide documented confirmation that electrical systems function in compliance with the criteria set forth in the contract documents to satisfy the operational needs of the owner.
- 1.2. Electrical commissioning provides, throughout the many phases of design and construction, a means for the owner to continuously communicate electrical systems criteria to the consultant/contractor and to rigorously verify compliance with these.

### 2. Scope

- 2.1. Prior to design, the owner will evaluate the facility's requirements regarding such issues as energy conservation, indoor environment, staff training, and operation and maintenance.
- 2.2. The owner/owner's consultant will review all phases of design and construction documents for:
  - 2.2.1. Compliance with design criteria,
  - 2.2.2. Commissioning requirements,
  - 2.2.3. Bidding issues,
  - 2.2.4. Construction coordination and installation concerns,
  - 2.2.5. Performance aspects, and
  - 2.2.6. Facilitation of operations and maintenance, including training and documentation.
- 2.3. The owner/owner's consultant will review the equipment submittals for compliance with commissioning issues.
- 2.4. The owner/owner's consultant will verify or manage the scheduling and procedures used for system start-up.
- 2.5. The owner/owner's consultant will verify that the training for the owner's operating staff is conducted in accordance with the project documents.
- 2.6. The owner/owner's consultant will verify that the operations & maintenance manuals comply with the contract documents.
- 2.7. Prior to expiration of the construction contract warranty, the owner will carry out functional performance testing (FPT).



- 2.8. The consultant/contractor will cooperate fully with the owner's commissioning initiatives and pay for all associated costs.
3. Equipment and Materials
  - 3.1. The owner will provide the following equipment and materials for FPT:
    - 3.1.1. Light meter.
    - 3.1.2. Receptacle tester.
    - 3.1.3. Clip-on ammeter.
    - 3.1.4. 2-way radios.
    - 3.1.5. Flashlights.
    - 3.1.6. Cameras.
    - 3.1.7. Documentation sheets.
  - 3.2. The contractor will provide all equipment not provided by the owner as required to perform all commissioning including FPT.
    - 3.2.1. Where a transfer switch and connection point for a portable generator have been provided for a building designated as an EMO site, the contractor shall provide a suitable portable generator, all associated wiring, equipment, materials and labor required to connect the generator to the transfer switch. The contractor shall provide all personnel and equipment required to test the functional operation of the emergency power system. This equipment shall remain the property of the contractor.
4. Submittals - The Contractor shall submit the following documentation prior to FPT:
  - 4.1. Record drawings, or a copy of the Contractors "Red Line" marked-up As-Built drawing shall be made available for use.
  - 4.2. Operations and maintenance manuals.
  - 4.3. A letter of acceptance from the inspection authority. A copy is to be included in the operations and maintenance manuals.
  - 4.4. A letter of guarantee. A copy is to be included in the operations and maintenance manuals.
  - 4.5. Copies of the following test results (A copy is to be included in the operations and maintenance manuals):
    - 4.5.1. Insulation/megger tests.
    - 4.5.2. Load balance tests on all transformers, the main switchboard, and distribution panels.

- 4.5.3. Voltage regulation/tap tests on all transformers.
- 4.5.4. Load tests on all electric motors.
- 4.5.5. Generator / UPS tests.
- 4.5.6. Structured cabling system link tests.
- 4.5.7. Fire alarm system verification.
- 4.6. A Commissioning and/or Certification Report from the manufacturer for the following systems (A copy is to be included in the operations and maintenance manuals):
  - 4.6.1. Security system.
  - 4.6.2. Multimedia system.
  - 4.6.3. Public Address system.
  - 4.6.4. Intercom system.
  - 4.6.5. CATV system.
  - 4.6.6. Dimming system.
  - 4.6.7. Assistive listening system.
- 4.7. Written verification from the end user that staff training has been performed according to the manufacturer's recommendation for the following (A copy is to be included in the operations and maintenance manuals):
  - 4.7.1. Dimming system.
  - 4.7.2. Main switchboard including digital meter.
  - 4.7.3. Generator and transfer switch.
  - 4.7.4. Motor Control Centres (MCC's).
  - 4.7.5. Fire alarm system.
  - 4.7.6. Security system(s).
  - 4.7.7. Multimedia system.
  - 4.7.8. Public address/intercom system.
  - 4.7.9. CATV system.
  - 4.7.10. Assistive listening system.
- 5. Functional Performance Testing (FPT)
  - 5.1. The Minister's Representative will commence a Functional Performance Testing (FPT) Program independent of other processes, upon receipt of written verification from the General Contractor that:

- 5.1.1. All systems are complete and operational in all respects.
- 5.1.2. All specified reports and documents have been submitted and approved.
- 5.1.3. All tests, commissioning and start-up processes are complete.
- 5.1.4. All demonstrations have been completed and documented.
- 5.1.5. All defects and deficiencies identified during the construction process and during the commissioning of all electrical systems have been corrected.
- 5.2. Allow for 1 day for every 10,000 square feet or portion thereof.
- 5.3. Provide an electrician and all manufacturer's technical representatives as required by the owner. Make all arrangements and pay for all associated costs.
- 5.4. FPT shall be performed on all electrical systems referenced in the contract documents which may include, but not be limited to, the following:
  - 5.4.1. Life Safety Systems:
    - 5.4.1.1. Emergency Lighting.
    - 5.4.1.2. Exit Signs.
    - 5.4.1.3. Fire Alarm System.
  - 5.4.2. Lighting System.
  - 5.4.3. Power Distribution System.
  - 5.4.4. Electric Heating System.
  - 5.4.5. Structured Cabling System.
  - 5.4.6. CATV System.
  - 5.4.7. Multi-Media System.
  - 5.4.8. Security System(s).
  - 5.4.9. Public Address System.
  - 5.4.10. Assistive Listening Systems.
  - 5.4.11. Intercom System.
  - 5.4.12. UPS System
- 5.5. Deficiencies or defects discovered during the FPT process are to be immediately rectified by the Electrical Contractor.

## Section 26 09 24 Instrumentation and Control for Electrical Systems

### 1. Lighting Control Equipment - Low Voltage

- 1.1. Provide a complete low voltage lighting control system as required. Provide a riser diagram on the drawings.
- 1.2. Lighting systems shall be controlled by means of low voltage switches for all applications unless noted otherwise.
  - 1.2.1. Utilize occupancy sensors in combination with low voltage switching to control lighting in individual common use rooms. Where occupancy sensors are utilized in buildings to control lighting, they shall not control lighting in stairwells or rooms where the primary source of illumination is slow to produce full lumen output.
  - 1.2.2. In large, open office areas, separate floor areas into zones based on their usage and provide automatic on/off control and a centralized master switch station with manual on/off control for each zone.
- 1.3. Low voltage lighting control systems.
  - 1.3.1. In all multi-storey buildings or buildings with complex interior layouts, provide a centralized, programmable lighting control system capable of interfacing with the building automation system. The system shall combine integrated control, supervision, data logging, alarms, scheduling, and programming/system management functions.
    - 1.3.1.1. The lighting control system shall be capable of time of day scheduling, weekend, and holiday scheduling.
    - 1.3.1.2. The system shall Provide means for manual and automatic control of each and every lighting circuit or relay leg. Input from automatic time of day clocks, occupancy sensors, and photo sensors to control lighting or other electrical loads shall be available for each relay while allowing individual override capability from as many local and remote areas as desired via switches.
    - 1.3.1.3. Blink Warn - the system shall automatically blink the lighting channel minutes prior to a scheduled shut-down. System shall be capable of interfacing with the Building Automation System (BAS) to turn on/off the lighting based on the building's normal operating schedule. System shall be capable of interfacing with the Building Security needs.

- 1.3.1.4. In the event of power loss, the lighting control system shall retain system status information for up to 72 hours in non-volatile memory.
  - 1.3.1.5. Programming of the lighting control system shall be via desktop or laptop computer. This computer shall not be necessary for running the system only for programming or operator override. The operations available from the remote computer shall have upload/download (for system alteration and backup) and diagnostic capability. The connected desktop or laptop computer shall be able to display the status of any relay or relay group and shall be able to switch any relay or relay group.
  - 1.3.1.6. Where the lighting control system configuration permits, the intrusion alarm system is to activate general area lighting as part of the annunciation of an intrusion alarm.
- 1.4. Switches:
- 1.4.1. Single pole, double throw, momentary contact, centre pivot rocker type action, with or without LED pilot lights as indicated.
  - 1.4.2. Switches containing LED pilot lights are to be wired in such manner as to indicate "red" status (pilot light) symbol as being in the "on" position, and "green" status symbol indicating switch as being in the "off" position. Red LED pilot light is to be oriented to be on top or upper side of switch.
  - 1.4.3. Light switches located in rooms containing light fixtures that they in turn control need not incorporate LED type pilot light function.
  - 1.4.4. Low voltage light switches controlling lighting fixtures installed in remote areas or rooms other than where actual light fixtures are located are to incorporate LED pilot light function.
  - 1.4.5. Where switches cannot be installed on latch side of door due to windows, provide mullion mounting where appropriate, ensure mounting straps are bonded.
- 1.5. Relay Panels:
- 1.5.1. Panels are to include a maximum of 12 relays, electrically operated by momentary pulse, mechanically latched, rated for 20A @ 347 volts, control transformer and suitable voltage barriers, c/w factory installed bonding and neutral termination strips.

- 1.5.2. Lighting relay panels shall contain both, 10% spare relays and 10% free space for the addition of future relays, with “minimum” of (2) spare relays.

**Section 26 20 00      Low Voltage Electrical Distribution**

1. Dry Type Transformers up to 600 Volts Primary
  - 1.1. All transformers 600V and below are to be dry type.
  - 1.2. Transformers are to be minimum K13 rated and contain only "copper" windings.
  - 1.3. Transformers are to accommodate 200% upsized neutrals.
  - 1.4. Transformers are to be bolted securely to concrete housekeeping pads.
  - 1.5. Vibration isolation:
    - 1.5.1. For transformers smaller than 112.5 KVA, rubber vibration isolating pads are to be placed below transformer support channels at each of four exterior corners, in locations where transformer has been secured (bolted) to concrete housekeeping pad.
    - 1.5.2. For transformers 112.5 KVA and larger, provide vibration isolation with double deflection neoprene vibration isolation mounts at the corners of the transformer. The mounts shall have a minimum static deflection of 0.35" (9mm). All metal surfaces shall be Neoprene covered to prevent corrosion and shall also have friction pads, both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole with cap screw and washer on top. Bolt isolation mounts to both the transformer and housekeeping pad.
  - 1.6. Transformers containing electrical termination points located on both front and rear sides of same, are not to be considered for use unless a "minimum" of not less than 1 metre of unobstructed clearance is provided completely around each of four sides.
  - 1.7. All dry type transformers are to be c/w a Dual Rated Spade Type Transformer Lug, sized as required to facilitate both, grounding and bonding conductor requirements.
    - 1.7.1. Lugs to be bolted directly to transformer enclosure (chassis) with a minimum of two 12.7mm bolts, flat and lock washers and accompanying nuts.
    - 1.7.2. Lugs to contain number of termination openings as necessary to ensure individual terminations of "each" ground and "each" bond conductor(s) is achieved.
  - 1.8. Transformers may be bottom or side fed with both primary and secondary conduits and associated conductors as follows:

- 1.8.1. Each "primary" raceway is to contain a "grounding" conductor sized to suit minimum the latest edition CEC requirements of transformer "XO" point where applicable, unless specifically indicated as being oversized. Where separately run grounding conductors are utilized, they are to be run in suitably sized conduit.
  - 1.8.2. Each "secondary" raceway is to contain a "bonding" conductor sized as per the latest edition CEC unless specifically indicated otherwise.
  - 1.8.3. Bottom fed transformers located on slab-on-grade type ground floors only, may be fed utilizing rigid, thickwall type PVC conduit, for both primary and secondary feeders.
- 1.9. All connections are to be made utilizing flexible metal conduit. If "liquid tight" flexible metal conduit is used, then the associated "liquid tight" connectors shall also be used.



## Section 26 24 00      Switchboards and Panelboards

### 1. Service Entrance Boards

- 1.1. Use metal enclosed assemblies c/w circuit breakers as required. Air circuit breakers are to be the draw-out type. Insulated case and moulded case circuit breakers are to be of the fixed type. Ensure voltage, current, and short circuit ratings of breakers meet code requirements for their particular application.
- 1.2. Main switchboards rated 600 amps and larger are to be "free-standing" c/w minimum working space of not less than 1270mm between any portion of the board and all walls surrounding same. This will accommodate future wall mounted electrical installations up to 270mm deep while maintaining the CEC required 1m clearance.
- 1.3. Free-standing switchboards are to be a minimum of 610mm in depth.
- 1.4. All free-standing switchboards are to be rigidly secured (bolted) to concrete housekeeping pads.
- 1.5. Free-standing switchboards rated 1000 Amps and larger are to include a bussed wireway enclosure for terminating "in-coming" feeder conductors. Bussed wireway section is to be not less than 610mm (24") in width.
- 1.6. Service entrance boards rated 250A and larger are to be complete with integral digital meter which displays volts, amps, power factor, frequency, kW, kVAR, kVA, THD, demand kW, demand kVAR, demand kVA, etc.
- 1.7. Switchboards readily identified and approved by the manufacturer as being suitable for a specific use, shall not under any circumstances be "field modified" to suit any other applications.
- 1.8. If not specifically designed for and designated as such by manufacturer as suitable for "free standing" application, electrical equipment shall be raised "off" floors, secured directly to walls and/or channel supports, and have their bottom entry raceways connected or terminated (directly to) the enclosures with appropriate steel type connectors. Additional supports as may be required, are to be installed between floor and underside, or bottom of enclosure.
- 1.9. Non-connected PVC or steel raceways protruding up through open bottoms of "free standing" switchboards require PVC bell ends and steel type "grounding bushings" installed on ends of respective types of conduits.
- 1.10. Extension handles are to be provided for all breakers sized 225 Amps and larger.

1.11. Provide TVSS protection in all service entrance boards as per Section 26 43 00

2. Panelboards - Breaker Type

2.1. Panelboards are to be c/w factory installed bonding terminal strips. Where more than one bonding terminal strip is present in any one panel, both shall be hard-wired together using identical size bonding conductor as one accompanying the panel feeder conductors.

2.2. Detail each new and/or existing panel on the drawings as per the following:

2.2.1. Location, Voltage and phase(s), Mounting options, Bus capacity, Total load, Individual load of branch circuit breaker(s), Size of main breaker where applicable.

2.2.2. Typewritten or computer-generated panel schedules are to indicate locations and types of "loads" each branch circuit breaker(s) feeds.

2.3. Kitchen panels shall incorporate shunt trip breaker(s) for the shutting down of ranges, deep fat fryers, grills, etc.

2.4. Panelboards for machine shops, carpentry shops, and/or other specifically defined areas, shall contain shunt trip "Main Breakers" c/w remote maintained red (emergency off) push buttons placed at all exits to the shops/areas. Lighting circuits are not to be fed from these types of panels.

2.4.1. Dust producing equipment ducted to the central dust collector must be interlocked with the dust collector control to prevent the operation of this equipment if the dust collector is not running.

2.5. The use of panelboards is "always" the required method of distribution. The use of splitter troughs combined with fused disconnect switches is not acceptable unless prior approval is obtained from the Minister's Representative.

2.6. Branch Circuit Panelboards (225A and smaller)

2.6.1. Each branch circuit shall be clearly identified on a typewritten directory, with directory being protected by a clear plastic cover.

2.6.2. Panelboard enclosures are not to be less than 508mm (20") in total width.

2.6.3. Branch circuit panelboards are to be fitted with lock type doors.

2.6.4. Panelboards are to be complete with the following:

2.6.4.1. Minimum of 10% spare 15-amp 1 pole circuit breakers.

2.6.4.2. Minimum of 10% spare spaces for 1 pole circuit breakers.

- 2.6.4.3. Minimum of 10% of breaker locking devices, based upon total number of circuit breakers that panel can accept.
- 2.6.5. Panelboards shall be centrally located within the servicing area to “minimize” excessive lengths of branch circuit wiring runs.
- 2.6.6. Branch circuit panelboards shall not be fed from other branch circuit panelboards.
- 2.6.7. All recessed panelboards shall have two 27mm (1”) empty EMT conduits stubbed up and out into the accessible ceiling space above the panel for future use. Each conduit shall be terminated in a 152 mm x 152 mm x 102 mm (6” x 6” x 4”) type ‘D’ box.
- 2.6.8. Branch circuit panel boards feeding electronic equipment shall be protected with TVSS protection as per Section 26 43 00.
- 2.7. Distribution Panelboards (above 225A)
  - 2.7.1. Distribution panelboards are to have their enclosures sized not less than 914mm (36”) wide x 279mm (11”) deep. Provide a minimum of 20% additional bussed space.
  - 2.7.2. Distribution panels readily identified and approved by the manufacturer as being suitable for a specific use, shall not under any circumstances be “field modified” to suit any other applications.
  - 2.7.3. If not specifically designed for and designated as such by manufacturer as suitable for “free standing” application, panelboards shall be raised “off” floors, secured directly to walls and/or channel supports, and have their bottom entry raceways connected or terminated (directly to) the enclosures with appropriate steel type connectors. Additional supports as may be required, are to be installed between floor and underside, or bottom of enclosure.
  - 2.7.4. Non-connected PVC or steel raceways protruding up through open bottoms of “free standing” panelboards require PVC bell ends, and steel type “grounding bushings” installed on “ends” of respective types of conduits.
  - 2.7.5. The use of single enclosure, combined distribution panelboard and branch circuit panelboards is strictly prohibited.
- 3. Motor Control Centers or Low Voltage Controllers
  - 3.1. Wall mounted “grouped motor control” type MCC’s may be used for groups of up to four starters.

- 3.2. Use standard motor control centres where more than four (4) motor starters are required in the same location. Centres should be enclosed, dead front, free-standing structures. Use combination starters. Mount centres on continuous mounting channels on raised concrete housekeeping pads. Specify control centres as per NEMA Standard for class and type. Cells shall be "minimum" 20" wide and 20" deep. Wiring shall be EEMAC 1 type B. Provide wireways at the top, bottom or side for proper installation of all wires.
- 3.3. Free standing MCC's are to be bolted to concrete housekeeping pads.
- 3.4. Provide minimum 20% bussed space in all MCC's.
- 3.5. Motor Control Centres readily identified and approved by the manufacturer as being suitable for a specific use, shall not under any circumstances be "field modified" to suit any other applications.
- 3.6. Non-connected PVC or steel raceways protruding up through open bottoms of free standing MCC's require PVC bell ends and steel type "grounding bushings" installed on ends of respective types of conduits.
- 3.7. Single-phase and Three-phase motor control centres mains shall be provided with a neutral conductor such that the control transformers located in motor starters can be connected Line-to-Neutral.

**Section 26 27 00      Low Voltage Distribution Equipment**

1. Receptacles:
  - 1.1. All receptacles are to be of “one” manufacturer throughout the project.
  - 1.2. Receptacles to be specification grade, white in colour and c/w stainless steel coverplates unless otherwise noted.
  - 1.3. All vertically installed 120 volt,15A U-ground receptacles are to be installed with the U-ground connection oriented to the upper, or top side.
  - 1.4. Horizontally installed 120-volt U-ground receptacles are to be installed with their neutral termination bolts located on the top side.
  - 1.5. “Pig-tail” type leads are to be installed on conductors in all device or outlet boxes where feeding through to other receptacles. “Daisy-chain” or looping through of conductors from one device to another is not acceptable. Provide separate pig-tail conductor leads for final termination to each receptacle for phase, neutral and bond conductors. All conductors are to be terminated on external, side wiring clamps suitable for #10 AWG conductors, "push in" type back wiring termination is not permitted.
  - 1.6. Each 120-volt U-Ground receptacle installed on the “exterior” of a building is to be mounted in a weatherproof enclosure incorporating a recessed box, heavy cast aluminum cover plate and enclosure keys.
  - 1.7. Provide “housekeeping” receptacles throughout buildings at a maximum 10m spacing. All rooms shall contain at least one “housekeeping” receptacle. These receptacles are to be rated 120V, 20A, T-slot type.
  - 1.8. In addition to normal quantity of 120-volt U-Ground receptacles indicated to be installed in “Mechanical” rooms, there shall be an additional quadraplex receptacle installed in common two gang “FS” box on “separate” 15 amp branch circuit c/w separate neutral and fed from nearest panelboard containing TVSS protection. Location of receptacle(s) will be as dictated by location of “controls” panel in same room.
  - 1.9. There shall be at least one exterior U-Ground receptacle installed on wall adjacent to every entry into a building, with each being fed from a “separate” 20A, single pole GFCI circuit breaker or faceless GFCI. These receptacles are to be rated 120V, 20A, T-slot type. Where there are multiple entries within 6m (or less) of each other, provide a single exterior receptacle adjacent to one of the entries only.
  - 1.10. All receptacles are to be “polarity” tested.

- 1.11. Ceiling receptacles for overhead projectors are to be mounted with the face in the vertical position to prevent plug-in type transformers from falling.
- 1.12. Unless otherwise noted, provide a 15A, 120V duplex receptacle adjacent all washroom sinks. Feed from a 15A, 1P GFCI breaker or faceless GFCI.
- 1.13. Receptacles for exercise equipment such as treadmills, step machines, bicycles, elliptical machines, etc. are to be rated 120V, 20A, T-slot type.
- 1.14. Receptacles requiring GFCI protection are to be fed from a GFCI circuit breaker or faceless GFCI.
- 1.15. Receptacles for computer use are to be provided as per the following:
  - 1.15.1. Quadruplex type receptacle, or two (ganged together) 120V U-Ground duplex receptacles (white in colour) grouped together in common (2) gang device box mounted behind a common stainless steel coverplate, are to be on the "same" branch circuit and provided for each workstation within 1m (3 feet) of the data outlet.
- 1.16. Electric Vehicle Charging Stations
  - 1.16.1. NEMA 3R exterior free-standing pedestal mounted housing. Housing to be mounted on concrete base.
  - 1.16.2. Level 2 electric vehicle charging stations,
  - 1.16.3. AC charging 120/208 VAC or 120/240 VAC by industry standard SAE J1772E power connector mounted on an 5490mm (18') cord.
  - 1.16.4. Capable of being integrated into the building access control system for on/off control. The access control system (or other control system) is to provide the initial on input signal and the charging system is to automatically turn off when power is disconnected from the vehicle.
  - 1.16.5. Equipment shall meet the requirements of UL 2231 personnel protection systems for EV charging circuits.
  - 1.16.6. Protect the charging stations from damage with bollards.
2. Switches:
  - 2.1. All light switches are to be of one manufacturer throughout project.
  - 2.2. Switches are to be white in colour, specification grade c/w stainless steel cover plates unless otherwise noted.
  - 2.3. Device "leveller and retainer" shall be used for securing devices to flush installed device boxes. This is particularly practicable where an enlarged opening around a box has been made, preventing device "ears" from coming into direct contact with finish wall as is intended.

- 2.4. Single gang adjustable "box extension" shall be used for extending single gang box openings a maximum of 22mm (7/8"). Their use is acceptable in non-combustible type walls where front edges of boxes have not been installed greater than 29mm (1-1/8"), or 6mm (1/4") from finish wall surface.
- 2.5. Control of 347 Volt indoor lighting shall be by low voltage switching. 347V line voltage switching shall be acceptable only in the following locations:
  - 2.5.1. Service rooms.
  - 2.5.2. Storage rooms.
  - 2.5.3. Electrical rooms.
  - 2.5.4. Mechanical rooms.
  - 2.5.5. Boiler rooms.
- 2.6. Where switches cannot be installed on latch side of door due to windows, provide mullion mounting where appropriate.
3. Heavy duty retractable electric extension cord reels:

Portable grounded cord reel with locking ratchet.

15m (50') of 14/3 yellow SJOW-A cord rated 13A, 125V.

Power outlet box c/w two (2) 15A, 120V duplex receptacles and strain relief, fed from separate 120V, 15A circuit.
4. All kitchens are to be wired similar to residential kitchens except that each split circuit shall be dedicated to one duplex receptacle only.

**Section 26 28 00      Low Voltage Circuit Protective Devices**

1. Fuses
  - 1.1. Provide three (3) spare fuses of each type and size installed above 600A.
  - 1.2. Provide six (6) spare fuses of each type and size installed up to and including 600A.
2. Disconnect Switches - Fused and Non-Fused Up To 1000 Volts
  - 2.1. Both fusible and non-fusible types of disconnect switches are to be type "A" - quick make- quick break, c/w types of enclosure(s) as required.
  - 2.2. Provisions for padlocking switch in either on or off positions.
  - 2.3. Door is to be mechanically interlocked so as to prevent opening of same when handle is in "on" position.
  - 2.4. Fuse holders to be suitable to accept size and type of fuses as specified.
  - 2.5. On - off position of switch is to be indicated on enclosure.
  - 2.6. Provide local non-fusible type disconnect switches for the following:
    - 2.6.1. Humidifiers and de-humidifiers.
    - 2.6.2. Duct Heaters.
    - 2.6.3. Domestic hot water heaters.
    - 2.6.4. Other types of equipment containing resistive type loads.26 28 16  
Enclosed Switch and Circuit Breakers
3. Breakers are to have sufficient interrupting capacity to withstand the available fault current. Series rating of breakers is not acceptable.
4. Circuit breakers shall be bolt-on type only. Multi-pole breakers are to have single handle. Tie-bars are not permitted
  - 4.1. The use of 'plug on, screwed in place' type circuit breakers are accepted under the following conditions:
    - 4.1.1. Installed in distribution panels which are rated 250A and above, and at least one breaker in a panel is larger than 100 A.
    - 4.1.2. Breaker's operation, performance, and characteristics comparable to that of a bolt-on circuit breaker.
    - 4.1.3. Plug-on connection shall be factory installed, integral to the circuit breaker, and paired with integral mounting bracket at the load side to secure circuit breaker to panel board. Circuit breaker connection



- must provide a secure and reliable means of connection to the panel board.
- 4.1.4. The plug-on breakers must connect to a front-to-back busbar assembly.
  - 4.1.5. The breaker and busbar assembly must feature slots and keys that interlock to prevent breaker movement in conjunction with an integral breaker mounting bracket that features retaining screws.
  - 4.1.6. The load side terminals of the plug-on breakers must indicate the corresponding phases of the terminals.
  - 4.1.7. The manufacturer's conductive compound must be used on all plug-on connections where recommended; an unopened tube of the manufacturer's conductive compound (if recommended) must be turned over to the building's maintenance staff along with the respective instruction manual.
  - 4.1.8. Install a Lamicoid label to the front of the panel which states "Notice: phasing of breaker terminals may vary between breakers. Refer to the phase marking next to each terminal."
  - 4.1.9. Multi-pole breakers are to have single handle. Tie-bars are not permitted.
  - 4.1.10. Thermal imaging of the breaker shall be able to show hotspots within the breaker's internal components, not only at connection points. The respective manufacturer shall agree to perform an annual preventative maintenance infrared scanning and thermal imaging of panel interiors under normal operating conditions upon occupancy of the building and at the end of the warranty period with both reviews witnessed by the Minister's Representative and submit all associated official documents and reports accordingly.
  - 4.1.11. Panels that accept plug on breakers shall indicate a warning that breakers shall not be installed while panel is live, with no exceptions.
5. Under no circumstances are the use of "mini" type circuit breakers acceptable.
  6. Both 120V and 347V lighting circuits are to be fed from 20 Amp, single pole circuit breakers unless indicated otherwise.

## Section 26 29 00      Low-Voltage Controllers

1. Contactors
  - 1.1. Provide two (2) normally open and two (2) normally closed auxiliary contacts.
2. Motor Starters to 600 Volts
  - 2.1. Coordinate control sequences to provide starters, and other auxiliary control equipment with the proper characteristics and features to obtain the performance intended.
  - 2.2. Provide disconnect switches, starters and auxiliary control equipment which are not an integral part of packaged units described in equipment specifications, but which are required for performance and sequence of operation of equipment specified under other Divisions.
  - 2.3. Motors sized one HP and larger are to be three-phase, where three phase power source is available.
  - 2.4. Check that the voltage drop due to motor starting is within acceptable limits. If required, use a reduced-voltage type starter.
  - 2.5. When a manual-automatic operation is required, use a "Hand-Off-Automatic" (HOA) selector switch. Connect the selector switch so that only the normal automatic regulating control devices will be bypassed when the switch is in the hand (manual) position. Connect "all" safety control devices, such as low or high pressure cutouts, high temperature cutouts, motor overload, in the control circuit in "both" the Hand and Automatic positions of the selector switch.
  - 2.6. All items (current sensors, etc.) affecting starter CSA certification (or equivalent) are to be factory installed. Field certification is to be avoided.
  - 2.7. Provide the following for all three-phase type motor starters:
    - 2.7.1. Magnetically operated MCP type motor starter.
    - 2.7.2. Fused 120V control transformer (confirm control voltage with mechanical discipline); the control transformer shall be fed line to neutral from one phase of the motor supply and an associated neutral conductor.
    - 2.7.3. Do not use a (3) position Hand/Off/Automatic (HOA) selector switch where only a (2) position On/Off selector switch is required.
    - 2.7.4. Solid state single phasing protection for all three phase motors.
    - 2.7.5. All pilot lights are to be of the LED type.
    - 2.7.6. Thermal overload protection to be provided on all three phases.

- 2.7.7. Short circuit protection in the form of a motor circuit protector (MCP).
- 2.8. Where manual motor starters are utilized, they are to be installed in a recessed backbox unless the starter is installed in a mechanical or an electrical room. Locate manual motor starters in limited access areas adjacent to the utilization equipment a maximum of 1220mm (48") AFF. Group manual motor starters where practicable. Do not mount starters in the accessible ceiling space.
  - 2.8.1. All single-phase manual motor starters are to meet the following requirements:
    - 2.8.1.1. Switching mechanism, quick make and break.
    - 2.8.1.2. One overload heater, manual reset, trip indicating handle.
    - 2.8.1.3. Accessories:
      - 2.8.1.3.1. Toggle switch: standard labeled as indicated.
      - 2.8.1.3.2. Indicating light: LED type and red in colour.
      - 2.8.1.3.3. Locking tab to permit padlocking in "ON" or "OFF" position.
      - 2.8.1.3.4. Recessed backbox to allow for flush mounting, unless noted otherwise.
- 3. Variable Frequency Motor Controllers
  - 3.1. Ensure that the VFD, load side wiring, and motor combination are completely compatible.
  - 3.2. Wiring on the load side of variable speed drives shall be specifically rated for this application. Regular wiring is not acceptable.
  - 3.3. Output waveform tests shall be performed on all VFD's. Submit test results to the engineer.
  - 3.4. Ensure all VFD's are properly ventilated.
  - 3.5. Provide circuitry to limit the total harmonic distortion (THD) on the line side of the VFD.
  - 3.6. Ensure that the VFD is rated for constant torque or variable torque loads as applicable.

**Section 26 32 00      Packaged Generator Assemblies**

1. Where required, provide a complete operational diesel emergency power generating system including all architectural, structural, mechanical, and electrical components.
2. The generator set is to be c/w the following:
  - 2.1. Engine.
  - 2.2. Generator.
  - 2.3. Controller.
  - 2.4. Instrument Panel.
  - 2.5. Accessories:
    - 2.5.1. Over voltage protection.
    - 2.5.2. Line circuit breaker.
    - 2.5.3. Exhaust silencer.
    - 2.5.4. Flexible exhaust connector.
    - 2.5.5. Radiator duct flange.
    - 2.5.6. Flexible fuel lines.
    - 2.5.7. Battery charger.
    - 2.5.8. Battery rack and cables.
    - 2.5.9. Run relay kit.
  - 2.6. Vibration isolation.
  - 2.7. CSA certification.
  - 2.8. Alarms: provide the following alarms
    - 2.8.1. Overcrank
    - 2.8.2. Low engine temperatures (i.e., too low for reliable start)
    - 2.8.3. High engine temperature pre-alarm
    - 2.8.4. High engine temperature
    - 2.8.5. Low lube oil pressure pre-alarm
    - 2.8.6. Low lube oil pressure
    - 2.8.7. Overspeed
    - 2.8.8. Low fuel (signals less than 2 h of fuel remaining)

- 2.8.9. Emergency electrical power supply system supplying load
  - 2.8.10. Control switch not in automatic position
  - 2.8.11. Low voltage in battery
  - 2.8.12. Lamp test
  - 2.8.13. Contacts for local and remote common alarm
  - 2.8.14. Audible alarm silencing switch
  - 2.8.15. Low starting air pressure (if applicable)
  - 2.8.16. Low starting hydraulic pressure (if applicable)
  - 2.8.17. Air shutdown damper (if applicable)
  - 2.8.18. Remote emergency stop station (if provided)
  - 2.8.19. Low coolant level (if applicable)
  - 2.8.20. Ventilation dampers not open
  - 2.8.21. Auxiliary supply tank containment leak sensing
  - 2.8.22. Automatic transfer switch in non-auto mode or bypass mode (if applicable)
  - 2.8.23. Underfrequency/underspeed
  - 2.8.24. Overcurrent
  - 2.8.25. Undervoltage
  - 2.8.26. Overvoltage
3. The generator is to be located within the building so as to minimize sound transfer to occupied spaces. Ensure generator rooms are remote from occupied areas that are either adjacent to, above, or below same. Provide buffer rooms, such as storage rooms, between generator rooms and other occupancies.
  4. Provide a minimum 5 year/2000 hour warranty.
  5. Provide a standard 5-year service contract, the cost of this contract is to be included with the supply and installation of this equipment. The service contract shall include (but not be limited to) the semi-annual, annual and five-year inspection test and maintenance requirements of the CSA C282 (if applicable).
  6. When a generator is permanently installed in such a way that the generator will carry all or any part of the distribution system for the building, the generator will be treated as service equipment under this Design Requirements Manual. Generator loading requirements will meet all service equipment requirements.

**Section 26 36 23      Automatic Transfer Switches**

1. The automatic transfer switch shall be c/w the following:
  - 1.1. Power transfer module.
  - 1.2. Separately mounted control module.
  - 1.3. Continuous duty contactors.
  - 1.4. Silver AC contacts.
  - 1.5. Rated to withstand the available fault current.
  - 1.6. Bypass and isolation.
  - 1.7. NEMA 1 enclosure.
  - 1.8. Accessories:
    - 1.8.1. Readily adjustable/programmable time delay for momentary outages, transfer, and engine cool down.
    - 1.8.2. Voltage and frequency sensing.
    - 1.8.3. Gold plated DC contacts.
    - 1.8.4. Auxiliary contacts.
    - 1.8.5. Pilot lights.
2. Provide a minimum 5 year/2000 hour warranty.
3. Provide a standard 5-year service contract, the cost of this contract is to be included with the supply and installation of this equipment. The service contract shall include (but not be limited to) the semi-annual, annual and 5-year inspection test and maintenance requirements of the CSA C282 (if applicable).
4. Where a transfer switch has been provided for a portable generator; a suitable weatherproof exterior building mounted connection point shall be provided

**Section 26 43 00      Transient Voltage Suppression (TVSS)**

1. Provide integral TVSS protection at the electrical power service entrance for all buildings where computerized or other electronic related equipment is in use as per the following:
  - 1.1. Operation and Environment:
    - 1.1.1. Voltage. The TVSS devices shall be suitable for the voltage and system configuration as indicated on the single line diagram(s).
    - 1.1.2. Maximum Continuous Operating Voltage (MCOV). The maximum continuous operating voltage of the suppressor unit shall be greater than 125% for 208Y/120V systems and 115% for 480V and 600V systems.
    - 1.1.3. Protection Modes. Transient voltage surge suppression paths shall be provided for all possible common and normal modes (between each line and ground, neutral and ground, line to line, and each line and neutral).
  - 1.2. Suppression:
    - 1.2.1. The maximum peak surge current capacity per phase of the specified units, based on the standard 8 x 20 microsecond current waveform (described in ANSI/IEEE C62.41-1991), is not less than 240,000 Amps for main entrance panel applications and 120,000 Amps for branch panel applications.
    - 1.2.2. Let-Through Voltage. The TVSS unit for main panel applications shall demonstrate peak voltage Let Through characteristics as listed below. Voltage is measured L-N for WYE configurations. Testing shall be performed in accordance with Category A3, B3 and C1 test wave forms as described in ANSI/IEEE C62.41 – 1991 (Guide for Surge Voltages in Low Voltage AC Power Circuits). Other aspects of the test shall be in accordance with ANSI/IEEE C62.45 - 1987 (Guide on Surge Testing for Equipment Connected to Low Voltage AC Power).

6000 Vpk L - N	CAT A3 Ring Wave, 200 Amp	CAT B3 Ring Wave, 500 Amp	CAT C1 Impulse, 3000 Amp
208 V Units	400 V	400 V	400 V
600 V Units	400 V	400 V	1200V

- 1.2.3. Each model shall be able to withstand 1,000 sequential impulses using the category C1, 6kV/3kA, 8 x 20 is waveform as described in ANSI/IEEE C62.42-1991 (IEEE Guide for Surge Voltages in Low-Voltage AC Power Circuits). The interval between impulses shall not exceed 30 seconds. The resultant peak let-through voltage of the last impulse shall not vary from the first impulse by more than + or - 10%.
- 1.2.4. Suppression System. The TVSS unit shall include an engineered solid-state high-performance suppression system, utilizing non-linear voltage dependant metal oxide varistors or selenium cells. The suppression system's components shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow or cause system upset of connected loads.
- 1.2.5. The TVSS clamping components shall have a response time rated less than 1 nanosecond. Filter components shall respond instantaneously.
- 1.3. Filtering:
  - 1.3.1. Noise Attenuation. The TVSS unit shall be listed under UL 1283 and contain a high- frequency extended range tracking filter. The filter shall reduce fast rise-time, high- frequency, error-producing transients and electrical line noise to harmless levels thus eliminating disturbances which may lead to system upset. Noise attenuation shall be a minimum of 45dB at 100 kHz based on standardized insertion loss data obtained utilizing the MIL-STD-220A, 50 ohm insertion loss methodology. Only manufacturers providing a documented attenuation value at 100 kHz will be considered. Spectrum analysis data may be required for support.
  - 1.3.2. Bandwidth. The TVSS unit(s) for main entrance panel application shall have an effective filtering bandwidth of 180 Hz to 50 MHZ.
- 1.4. General Features:
  - 1.4.1. Connectors. Terminals shall be provided for all of the necessary input and output power and ground connections on the TVSS.



- 1.4.2. Internal Connections. All surge current diversion connections shall be by way of low impedance wiring. Surge current diversion components shall be wired for reliable low impedance connections. No printed circuit boards shall be used for surge suppression paths.
  - 1.4.3. Enclosure. The specified system shall be provided in a heavy duty NEMA 12 dust tight, enclosure with no ventilation openings. Indication of surge current module status shall be visible without opening the door.
  - 1.4.4. Unit Status Indicators. Red status indicators shall be provided on the hinged front cover to indicate unit phase status. The absence of the red light shall reliably indicate that one or more surge current diversion phases have failed and that service is needed to restore full operation.
  - 1.4.5. Fuses. The unit shall utilize internal fuses rated 600 VAC or greater and with a minimum interrupting capability of 200,000A or greater.
  - 1.4.6. Identification. The unit shall include manufacturer's nameplate, UL rating, and a CSA approval on the exterior of the enclosure.
  - 1.4.7. Warranty. The manufacturer shall provide a Five-Year Warranty from date of shipment.
  - 1.4.8. Quality. Testing of each unit shall include but shall not be limited to quality assurance checks, a "Hi-Pot" test at two times rated voltage plus 1000 volts per UL requirements, and operational and calibration tests. Test results will be made available to the Engineer upon request.
2. Provide integral TVSS protection within all branch circuit panels which feed computerized equipment as per the following:
    - 2.1. Operation And Environment:
      - 2.1.1. Voltage. The TVSS devices shall be suitable for the voltage and systems configuration as indicated on the single line diagram(s)
      - 2.1.2. Maximum Continuous Operating Voltage (MCOV). The maximum continuous operating voltage of the suppressor unit shall be greater than 125% for 208Y/120V systems and 115% for 480V and 600V systems.
      - 2.1.3. Protection Modes. Transient voltage surge suppression paths shall be provided for all possible common and normal modes (between each line and ground, neutral and ground, line to line, and each line and neutral).

2.2. Suppression Component:

- 2.2.1. Surge Current. The unit's maximum peak surge current capacity per phase based on the standard 8 x 20 $\mu$ s waveform (described in ANSI/IEEE C62.41-1991), shall be not less than 120,000 Amps. Total device peak surge current rating shall be not less than 300,000 Amps.
- 2.2.2. Let-Through Voltage. The Integrated Filtering Panelboard shall demonstrate the following peak Let Through Voltage when measured at the panelboard bus bar. Test points at the panelboard bus bar demonstrate actual distribution system transient let-through voltages. UL1449 ratings established at test points other than the bus bar, shall not be considered. Testing shall be performed utilizing Category B3 and C1 test wave forms as described in ANSI/IEEE C62.41 – 1991. The test procedure shall be in accordance with ANSI/IEEE C62.45 – 1987 and shall be conducted on the device as a finished product complete with integral fusing.

IEEE C62.41 (1991) Let Through Voltages (208Y/120V Units)

**Category B3/C1 Impulse**

**(Combination Waveform)**

**L-L 680 Volts**

**L-N 430 Volts**

**L-G 430 Volts**

**N-G 380 Volts**

(For Delta configurations, IEEE Let Through is measured L-L and L-G).

- 2.2.3. Each unit shall be capable of withstanding 3,000 sequential, Category C1, 8 x 20 is impulses as described and conducted in ANSI/IEEE C62.42-1991 and C62.45 –1987. The interval between impulses shall not exceed 30 seconds. The resultant Let Through Voltage of the last impulse shall not vary from the first impulse by more than +5%.

- 2.2.4. Suppression System. The TVSS filtering unit shall include an engineered solid-state high- performance suppression system, utilizing non-linear voltage dependent metal oxide varistors or selenium cells. The suppression system's components shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow or cause system upset of connected loads.
- 2.2.5. The TVSS clamping components shall have a response time rated less than 1 nanosecond. Filter components shall respond instantaneously.
- 2.3. Filtering:
  - 2.3.1. Noise Attenuation. The TVSS unit shall be listed under UL1283 and contain a high- frequency extended range tracking filter. The filter shall reduce fast rise-time, high- frequency, error-producing transients and electrical line noise to harmless levels thus eliminating disturbances which may lead to system up-set. Noise attenuation shall be a minimum of -45db at 100 kHz based on standardized insertion loss data obtained utilizing the MIL-STD-220A, 50 ohm insertion loss methodology. Only manufacturers providing a documented value at 100 kHz will be considered. Spectrum analysis may be required for support.
  - 2.3.2. Bandwidth. The TVSS filter shall have an effective filtering bandwidth of 10 kHz to 50 MHZ.
- 2.4. General Features:
- 2.5. The Integrated TVSS Panel shall be fully integrated. The TVSS unit shall be factory installed and connected to the bus bar. Field installed TVSS component products will not be considered. The integrated panelboard is to be factory tested as a complete unit to ensure completed product integrity.
- 2.6. Suppression/Filter System Connections. No plug-in component modules, quick- disconnect terminals or printed circuit boards shall be used in surge current-carrying paths.
- 2.7. The unit will have visual indicator lights for each phase of operation. The system will continuously monitor the operating status of each phase of suppression protection. If the unit is in proper working order, the indicator lights will be illuminated. If unit performance is degraded, the lamps will no longer be illuminated. These indicators must be visible without removal of the panel trim.

- 2.8. Fuses. The TVSS/filter system shall utilize internal fuses rated with a minimum interrupting rating of 200,000 AIC.
- 2.9. Identification. The unit shall include manufacturer's nameplate and CSA approval on the exterior of the enclosure.
- 2.10. Warranty. Provide a Limited Five-Year Warranty on the TVSS filter. This warranty shall commence from date of shipment.
- 2.11. Testing. Testing of each unit shall include quality assurance checks, "Hi-Pot" test at two times rated voltage plus 1000 volts per UL requirements, and operational and calibration tests.
3. All AC power receptacles feeding main communications equipment shall be integral TVSS type, in addition to being fed from a branch circuit panel protected by an integral TVSS.
4. All neutral conductors between the distribution transformer and the TVSS equipped branch circuit panel shall be sized @ 200% of code.

**Section 26 50 00      Lighting**

1. For each room or area determine the task performed and provide maintained, uniform lighting levels per IES standards unless otherwise specified herein.
2. The application of ANSI/ASHRAE/IESNA Standard 90.1 shall be on a project by project basis. Coordinate with the Minister's Representative.
3. Where a 347/600-volt electrical system is available, the lighting system shall be 347 V. The use of 120V lighting is to be pre-approved by the Minister's Representative.
4. All lighting fixtures shall be "specification grade" and shall be specified with a unique fixture designation, detailed description which includes voltage, mounting, wattage etc.
5. Interior lighting
  - 5.1. Generally interior lighting systems shall utilize 4', recessed LED fixtures (troffers) unless otherwise noted. Troffers shall incorporate the following:
    - 5.1.1. Lenses shall be pattern 12 low brightness UV stabilized, 100% virgin acrylic lenses (0.125"). A minimum thickness of 0.125" shall be used regardless of manufacturers pattern 12 designation.
    - 5.1.2. In order to reduce source image, a minimum distance between light source bottom to lens bottom of 50mm (2") must be maintained.
    - 5.1.3. Hinged, latched, steel door frame c/w mechanical light leak seals or gaskets.
    - 5.1.4. The fixture output shall not exceed 5400 lumens for ceiling / mounting heights 3m (10') or less.
    - 5.1.5. Suitable for both T-bar and drywall installation c/w frame-in kits as required.
    - 5.1.6. Driver and LED boards are to be accessible from the room side of the fixture. LED boards are to be individually replaceable.
    - 5.1.7. LED fixture drivers shall have a Total Harmonic Distortion (THD) less than 20%.
    - 5.1.8. Design lumen output shall be the average output of the fixture based on the IES LM-80 standard and TM-21.
    - 5.1.9. CSA approved.
    - 5.1.10. LEDs shall have a colour temperature of 3500K and a minimum CRI of 80 for typical office and support spaces. Provide fixtures with different CRI values or different colour temperature where the use of

- the space or application requires it - obtain approval from the Minister's Representative before proceeding.
- 5.2. Provide local switching for enclosed rooms, i.e. conference/board rooms, private offices, training rooms, etc. For large areas provide some centralized control to adequately cover appropriate areas at each entrance. Refer to 26 09 24 Instrumentation and Control for Electrical Systems for detailed requirements.
  - 5.3. Offices shall have a minimum average maintained illuminance level of 40 foot-candles (400 lux).
  - 5.4. Every washroom toilet stall shall have direct illumination from a light fixture or portion thereof.
  - 5.5. General lighting within stairwells and associated landings:
    - 5.5.1. Recessed Lighting fixtures are to be only located in ceiling spaces immediately "prior to" ascending or descending stairs and are not to extend beyond same.
    - 5.5.2. Lighting fixtures installed on end or side walls directly above "landings," are not to be greater than 3.35m (11') AFF to bottom of same.
    - 5.5.3. Lighting fixtures are not to be installed in, or on, ceilings or walls directly above intermediate stairs located between landings.
  - 5.6. Provide task lighting above all sinks.
  - 5.7. Valence lighting shall be provided under all cupboards installed above counters. Utilize strip lights in an architectural valence. The lack of an architectural valence shall not be permitted.
  - 5.8. Every shower stall shall have direct illumination from a light fixture or portion thereof.
  - 5.9. Light fixture locations are to be coordinated with mechanical ductwork so as to avoid conflicts. Allow a buffer zone to avoid light fixtures burning ductwork.
  - 5.10. All interior surface mounted lighting fixtures are to be provided with a flush mounted outlet box.
  - 5.11. Recessed Down Light
    - 5.11.1. Non-Accessible Ceilings:
      - 5.11.1.1. If the luminaire opening is less than 150mm (6") in diameter, a separate fixture drop shall be provided.
      - 5.11.1.2. Fixture drops shall be run to an accessible junction box above an accessible ceiling or an access panel.

- 5.11.1.3. Fixture drops shall not exceed 5m (15') in length.
- 5.11.2. Accessible T-bar Ceilings:
  - 5.11.2.1. Fixtures are to be securely fastened to the T-bar ceiling. No part of the fixture is to derive support from the T-bar ceiling tiles.
- 5.12. Provide LED High / Low bay fixtures to suit mounting height.
- 5.13. Recessed and/or surface type light fixtures, unless installed end-to-end are not to be wired in a "daisy-chain" manner or have their power sources looped between fixtures.
- 5.14. The following wiring methods are related to the installation of lay-in type lighting fixtures installed within T-Bar or other removable types grid ceilings:
  - 5.14.1. Additional T-Bar grid supports that may be required for light fixtures installed in, or secured to, T-Bar type ceilings, are to be identified accordingly to the applicable ceiling contractor, who in turn will be responsible for supplying and installing additional hangers as may be required.
  - 5.14.2. The installation of any "additional" T-Bar grid ceiling support wires is the sole responsibility of the ceiling installation contractor.
  - 5.14.3. Independent supporting of light fixtures in T-Bar grid ceilings utilizing materials other than tie-wires, i.e. threaded rods, metal channels, etc., are the sole responsibility of the electrical contractor.
  - 5.14.4. Each light fixture is to have a separate "fixture drop" installed and connected to hard wired junction or outlet box located in ceiling space.
  - 5.14.5. A maximum of four drops is permitted from any single box, regardless of box size.
  - 5.14.6. AC-90 fixture drops may only be supported from T-Bar ceiling grid support wires with "metal" type clips, approved for this particular application. The use of tye-wraps is prohibited.
  - 5.14.7. Modular Wiring:
    - 5.14.7.1. Fixtures recessed in, or secured to, T-Bar type ceilings incorporating C.S.A. approved type (modular) wiring harness system intended for interconnecting fixtures, is an acceptable alternative to supplying individual "hard wired" fixture (power) drops.
    - 5.14.7.2. Modular type harness wiring, may only be supported from T-Bar ceiling grid support wires with "metal" type clips,

approved for this particular application. The use of tie-wraps is prohibited.

- 5.14.7.3. Combined uses of both "Master" and "Slave" lighting fixtures shall be restricted to one "master" fixture with one accompanying "slave" unit.
- 5.14.7.4. Each "lay-in" type fixture shall be capable of being raised upwards and moved laterally in any direction a minimum of not less than 24".
- 5.14.7.5. Total length of "modular" wiring harness and accompanying conductors installed between "master" fixture and accompanying "slave" fixture, (including 1m (3') of wire within each fixture) is not under any circumstances to exceed 5.3m (17') in total length. Maximum of 3.3m (11') of flex, including associated conductors permitted to be used between "Master" and "Slave" fixtures (3.3m + 1m + 1m = 5.3m) (11' + 3' + 3' = 17').

## 6. Garage Bay Lighting

- 6.1. Utilize LED fixtures with a CRI in excess of 75 and a colour temperature of below 5000K for garage bay lighting.
- 6.2. Where motorized vehicles can be parked inside of a building, light fixtures shall not be located in the bays above the vehicles. The fixtures shall be installed between the bays so as to minimize shadowing caused by the vehicles.
- 6.3. Provide 50 foot-candles, average, maintained and 35 foot-candles vertical, average maintained on the vehicle sides.
- 6.4. Provide minimum 10% un-switched night light fixtures.
- 6.5. Fixtures shall have a maximum 15,000 lumen output and ensure diffusers and / or lenses are provided for LED fixtures to minimize glare for workers lying on the floor.
- 6.6. The fixture shall have an injection molded, 100% virgin UV stabilized acrylic, gasketed refractor/lens. All fixtures shall be vapor tight with a vapor tight optical assembly. Refractor /lens is to be hinged and latched so that no tools are required for access.
- 6.7. Fixtures shall be vapor tight, suitable for cold temperatures and damp locations.

## 7. Salt Dome Lighting

- 7.1. Provide 15 foot-candles horizontal, average, maintained.



- 7.2. Fixtures are to be LED High / Low bay fixtures. LEDs are to have a CRI in excess of 75 and a colour temperature of below 5000K. These fixtures shall be suitable for highly corrosive atmospheres, cold temperatures and wet locations. The fixtures shall be vapor tight with a vapor tight optical assembly (IP65, IP66 and IP67 rated) with a borosilicate glass or Injection molded, 100% virgin UV stabilized acrylic, gasketed refractor/lens c/w stainless steel latching hardware.
- 7.3. Fixtures shall be mounted to a support structure using stainless steel hardware in such a manner to prevent movement of the fixture. Provide bird guards on all exposed equipment.
- 7.4. Fixture to meets IESNA LM-80.
8. Exterior Lighting:
  - 8.1. Provide exterior lighting where required for driveways, walks, parking areas, and building perimeters using LED fixtures with a CRI in excess of 75 and a colour temperature below 5000K.
  - 8.2. All exterior building entrance doors shall be provided with a dedicated lighting fixture for security purposes.
  - 8.3. Provide exterior lighting where required for driveways, walks, parking areas, and building perimeters using LED fixtures with a CRI in excess of 75 and a colour temperature below 5000K. Exterior lighting shall be controlled using a photocell in conjunction with a programmable time clock complete with battery back-up and a manual bypass. If the time clock has an astronomic feature, then a photocell is not required. Exterior lighting to be "dark skies" compliant. Alternately, the Building Automation System may be used for exterior lighting control. Provide the following average, maintained illumination levels:
    - 8.3.1. Landscaped areas: 1 fc, extended 20' away from the building
    - 8.3.2. Parking lots: 1 fc
    - 8.3.3. Sidewalks: 1 fc
    - 8.3.4. Driveways / Roadways: 1 fc
9. Existing PCB type ballasts are to be disposed of according to Government legislation concerning the removal and disposal of hazardous waste.
10. The use of HID fixtures is not recommended, provide LED High / Low bay fixtures to suit mounting heights.
11. LED High / Low bay fixtures are to have a CRI in excess of 75 and a colour temperature below 4000K.

12. Ensure diffusers and / or lenses are provided for LED High / Low bay fixtures to minimize direct glare.
  - 12.1. Provide the following average, maintained illumination levels:
    - 12.1.1. Landscaped areas: 1 fc, extended 20' away from the building
    - 12.1.2. Parking lots: 1 fc
    - 12.1.3. Sidewalks: 1 fc
    - 12.1.4. Driveways / Roadways: 1 fc
13. Existing PCB type ballasts are to be disposed of according to Government legislation concerning the removal and disposal of hazardous waste.
14. The following wiring methods are related to the installation of lay-in type lighting fixtures installed within T-Bar or other removable types grid ceilings:
  - 14.1. Additional T-Bar grid supports that may be required for light fixtures installed in, or secured to, T-Bar type ceilings, are to be identified accordingly to the applicable ceiling contractor, who in turn will be responsible for supplying and installing additional hangers as may be required.
  - 14.2. The installation of any "additional" T-Bar grid ceiling support wires is the sole responsibility of the ceiling installation contractor.
  - 14.3. Independent supporting of light fixtures in T-Bar grid ceilings utilizing materials other than tie-wires, i.e. threaded rods, metal channels, etc., are the sole responsibility of the electrical contractor.
  - 14.4. Each light fixture is to have a separate "fixture drop" installed and connected to hard wired junction or outlet box located in ceiling space.
  - 14.5. A maximum of four drops is permitted from any single box, regardless of box size.
  - 14.6. Recessed and/or surface type fluorescent light fixtures, unless installed end-to-end are not to be wired in a "daisy-chain" manner or have their power sources looped between fixtures.
  - 14.7. AC-90 fixture drops may only be supported from T-Bar ceiling grid support wires with "metal" type clips, approved for this particular application. The use of tie-wraps is prohibited.
  - 14.8. Modular Wiring:
    - 14.8.1. Fixtures recessed in, or secured to, T-Bar type ceilings incorporating C.S.A. approved type (modular) wiring harness system intended for interconnecting fixtures, is an acceptable alternative to supplying individual "hard wired" fixture (power) drops.

- 14.8.2. Modular type harness wiring may only be supported from T-Bar ceiling grid support wires with "metal" type clips, approved for this particular application. The use of tie-wraps is prohibited.
  - 14.8.3. Combined uses of both "Master" and "Slave" lighting fixtures shall be restricted to one "master" fixture with one accompanying "slave" unit.
  - 14.8.4. Each "lay-in" type fixture shall be capable of being raised upwards and moved laterally in any direction a minimum of not less than 24".
  - 14.8.5. Total length of "modular" wiring harness and accompanying conductors installed between "master" fixture and accompanying "slave" fixture, (including 3' of wire within each fixture) is not under any circumstances to exceed 5.3m (17') in total length. Maximum of 3.5m (11') of flex, including associated conductors permitted to be used between "Master" and "Slave" fixtures (3.3m + 1m + 1m = 5.3m) (11' + 3' + 3' = 17').
15. Provide 5% spare of each type of fixture installed.
16. Garage Bay Lighting:
- 16.1. Where motorized vehicles can be parked inside of a building, light fixtures shall not be located in the bays above the vehicles. The fixtures shall be installed between the bays so as to minimize shadowing caused by the vehicles.
  - 16.2. Provide 50 foot-candles, average, maintained.
  - 16.3. Provide minimum 10% unswitched night light fixtures.
  - 16.4. Low Bay type LED fixtures shall be utilized as follows:
    - 16.4.1. Maximum 250W LED arrays shall be utilized to minimize glare for workers lying on the floor.
    - 16.4.2. Injection molded, 100% virgin UV stabilized acrylic, gasketed lens. Lens is to be hinged and latched so that no tools are required for access to fixture.
    - 16.4.3. High power factor driver.
    - 16.4.4. Suitable for cold temperatures and damp locations.
  - 16.5. Accessible T-bar Ceilings:
    - 16.5.1. Fixtures are to be securely fastened to the T-bar ceiling. No part of the fixture is to derive support from the T-bar ceiling tiles.

**Section 26 52 00      Emergency Lighting**

1. Provide emergency lighting as required by the National and Provincial Building Code as a minimum.
2. Units shall be connected to the same circuit as the general lighting fixtures for that area. Remote heads shall cover only those areas on the same branch circuit as the emergency battery unit is fed from.
3. Units shall be installed in critical areas even if emergency power (i.e. diesel generator, UPS) is provided. Critical areas include:
  - 3.1. Electrical rooms, unit equipment in electrical rooms shall provide illumination for four (4) hours as a minimum.
  - 3.2. Mechanical rooms (including but not limited to Boiler rooms, sprinkler rooms etc.).
  - 3.3. Kitchens with stoves.
4. Units shall incorporate sealed maintenance free batteries complete with solid state charger, automatic self-diagnostic circuitry, test switch, and LED indicators for "on" and "charge".
5. Batteries are to "each" have a (10) year life warranty.
6. Emergency light units containing "batteries," are to be flush installed in both, T-Bar and dry- wall type ceilings as per the following:
  - 6.1. Flush installed units installed in "dry-wall" type ceilings incorporating batteries, shall contain a "frame-in" kit intended for this particular application.
  - 6.2. Flush installed units installed in T-Bar type ceilings shall be suitable for this particular application.
7. Where installed in the following areas, emergency lighting shall be located:
  - 7.1. In the middle (between corridor walls) or center of all corridor ceilings.
  - 7.2. On ceilings or walls prior to ascending or descending stairs.
  - 7.3. On rear, and/or "landing" side walls as may be required. Where installed on rear wall of landing, approximately 300mm (12") of space shall be provided between top of wall mounted lighting fixture and bottom of remote emergency head.
8. The line supply voltage is to match the voltage of the local lighting system. If there are two voltages present in the same area, the higher voltage shall be utilized.
9. Utilize LED lamps to minimize maintenance requirements.

10. Remote heads shall be fed from unit equipment using conduit and wire. A transition from conduit and wire to AC90 cable as the drop to the equipment is permitted above accessible ceilings where the length of the AC90 cable is less than 4.5m (15'), and where the transition to AC90 is located in the same room as the remote head.

**Section 26 53 00      Exit Signs**

1. Provide exit lighting as required by the National and Provincial Building Code as a minimum.
2. Exit lights shall be die cast, soft designer look, LED type complete with DC backup. Specification grade. Faceplate to be fastened with appropriate screws.
3. Exit lighting fixtures shall be wall mounted 2286 mm (7'-6") A.F.F. Where this equipment is located above or over doors, it shall be wall mounted 152 mm (6") above the door frame. Hang from ceilings only where wall mounting is not feasible to a maximum height of 3350 (11'-0"), stem hang where necessary.
4. Provide a (10) year life warranty.

**END**

## DIVISION 27 - COMMUNICATIONS

### Section 27 00 00      Communications - General

#### 1. General

- 1.1. Varying, or deviating from any item(s) indicated in this document must be approved by the Minister's Representative. the Minister's Representative will not grant a deviation from these requirements unless the deviation has been submitted in writing for review and approved prior to proceeding with the design.
- 1.2. Materials and methodology employed for the installation of telephone and computer structured cabling systems shall be as per the Nova Scotia Government Structured Cabling Guidelines Information Transport Systems and the DC350 as a minimum. Where these references are at variance with each other, the more stringent requirements shall govern.
- 1.3. For Educational facilities the requirements identified in DC350 parts 1 and 2, the Nova Scotia Government Structured Cabling Guidelines Information Transport Systems, and ANSI/BICSI 001 Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities shall be incorporated. Where these references are at variance with each other, the more stringent requirements shall govern.
- 1.4. For Healthcare facilities the requirements identified in DC350 part 1, the Nova Scotia Government Structured Cabling Guidelines Information Transport Systems, and ANSI/BICSI 004 Information Communication Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities shall be incorporated. Where these references are at variance with each other, the more stringent requirements shall govern.
- 1.5. All communications room lighting shall be designed to be 40 fc at floor level.
- 1.6. Provide two (2) telecommunications outlets in each office, locate the outlets to accommodate furniture layout changes.

#### 2. Provide Wireless Access Points (WAP) per the following:

- 2.1. in open area office spaces, one WAP per 83 square meters (900 square feet),
- 2.2. in boardrooms and meeting rooms,
- 2.3. in corridors at 12 metre (40') spacings
- 2.4. WAP are to be located above the accessible ceiling.

- 2.5. Where the size and or complexity of the facility requires specialized design, a heat map shall be provided to verify the wireless network system design. The requirement to provide the heatmap shall be determined by the Minister's Representative.
3. Equipment shall not carry any logos or text which identifies the equipment manufacturer / supplier; exception: equipment located in service spaces



**Section 27 10 00      Structured Cabling**

1. Materials and methodology employed for the installation of telephone and computer structured cabling systems shall be as per the Nova Scotia Government Structured Cabling Guidelines Information Transport Systems as a minimum (Refer to Electrical Appendix guidelines attached at the end of Part 1), with the following changes:
  - 1.1. The conduit shall be sized to accommodate the # of cables serving the room plus 25% spare for future installations above and beyond code conduit fill requirements. Minimum conduit size shall be 27mm (1").
2. Where more than one room might be required to facilitate terminations due to cable lengths exceeding maximum lengths of 90 m, additional satellite communications rooms/closets shall be provided as required. These rooms may also contain power distribution branch circuit panelboards provided that all required clearances are met.
3. All communications rooms shall be sized as per the NS Government Structured Cabling Guidelines as a minimum. In facilities which fall under the major occupancy classification groups as defined in the National Building Code of Canada, are larger than 2800 square metres (30,000 sq ft) and incorporate construction materials which absorb or reflect radio signals, for example: low e glass, reinforced concrete, metal Q-deck etc. shall include the following provisions for a future (NIC) Distributed Antenna System (DAS).
  - 3.1. Provide space for a future 4 post cabinet in the main telecommunications room, ensure sufficient cooling is provided in this room to accommodate an additional 2000 watt electrical load for the equipment to be installed in the future cabinet.
  - 3.2. Plan for space and infrastructure to be available for the possible future NIC equipment to be installed,
  - 3.3. Provide a dedicated conduit sleeve(s) for future DAS from each telecommunications room into the adjacent corridor.
4. Unless specifically indicated otherwise, "minimum" CMR (FT-4) rated cable is to be used throughout.
5. Cables above T-bar ceiling are to be located within 750mm (30"), of T-bar ceiling.
6. In renovations, review existing main services to ensure they are adequate to accommodate upgrades and re- design these services as required.
7. All systems shall be installed by qualified personnel, such as a Construction Electrician or Communications Technician certified by the Nova Scotia Apprenticeship Agency.

8. Where the "grouping" of various systems outlets or multiple type outlets in dry-wall type construction is desirable, the use of "box mounting brackets" are to be installed between and secured to both metal studs.
9. Outlet identification shall be as described in the NS Government Structured Cabling Guidelines.
10. All cable identification shall be located adjacent connectors.
11. Cable Tray
  - 11.1. Where communications cables are permitted to be installed in a ceiling space without the benefit of conduit, main runs shall be installed in a heavy duty, aluminum, ladder type cable tray, minimum side rail depth 100mm (4"), sized to carry applicable cables plus 25% spare.
  - 11.2. Ladder type cable trays are to be installed in corridors. Ladder type or wire basket type shall be used in Equipment Rooms (ER) and Telecommunications Rooms (TR) as per the NS Government Structured Cabling Guidelines. Provide conduit pathway(s) from the cable tray to the room(s) containing the work area outlet(s); conduit size(s) and quantities shall conform to the NS Government Structured Cabling Guidelines.
  - 11.3. Cable tray is to be used for all communication cables not run in conduit/raceway.
  - 11.4. Cable trays (and their support systems) shall not be used as a means of support for any other system.
12. Communication cables are to be installed as per the following guidelines:
  - 12.1. Cables are to be installed parallel and perpendicular to building lines up to wall where they in turn are either drawn in conduit sleeves or concealed in dry-wall type partitions.
  - 12.2. The securing and/or supporting of low voltage cables to the "structure" is not to exceed 48" intervals.
  - 12.3. Where cables are permitted to be run from room to room, the use of EMT wall sleeves will be permitted subject to the following conditions: EMT conduit is to be reamed (both ends) prior to installation; EMT conduit is to be secured to the wall or ceiling structure using the manufacturers approved fastening / support system. Provide and install screw-on metal (malleable) type bushings on one end of the EMT conduit (complete with bonding connection) and an "Arlington" type plastic bushing on the other end are to be used with the EMT wall stub.
13. Ensure that design/construction of structured cabling systems is coordinated with end user IT personnel and shall be approved by the Minister's Representative.

14. All voice work shall be coordinated with the Telephone Authority, and requirements for each project shall be approved by the Minister's Representative.
15. Provide a single voice outlet and single data outlet in each mechanical room/space containing mechanical equipment.

**END**

## DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

### Section 28 00 00      Electronic Safety and Security - General

1. Equipment shall not carry any logos or text which identifies the equipment manufacturer / supplier; exception: equipment located in service spaces.
2. Electronic security systems may include intrusion alarm, access control, and video surveillance systems. Provide a riser diagram for each individual system on the drawings.
3. Security system wiring shall be installed in conduit/enclosed raceway in its entirety.
4. ULC certification is required on all security system components.
5. Intrusion Alarm/Access Control
  - 5.1. Intrusion alarm/access control system zones are to match the architectural zoning. Ensure specific public areas can be secured.
  - 5.2. Intrusion alarm initiating devices are to be of the addressable type.
  - 5.3. Provide a complete intrusion alarm/access control system, including coverage to all areas of the building containing exterior windows and/or doors as per the following:
    - 5.3.1. Door contacts for exterior doors.
    - 5.3.2. Door strikes.
    - 5.3.3. Magnetic locks are not to be used without prior approval of the Minister's Representative.
    - 5.3.4. Card readers.
    - 5.3.5. Motion sensors.
      - 5.3.5.1. Motion sensors are to always be located in ceilings. Where motion sensors are installed in t-bar ceilings, the motion sensor shall be securely mounted by the following method: a 100mm (4") square box shall be supported by the grid system using a bar hanger, a single gang round tile ring, sized accordingly, shall be mounted to the box flush to the underside (room interior) of the ceiling; mount the security system motion detector to the tile ring. Approval for wall mounted motion detectors must be obtained from the Minister's Representative before proceeding.
      - 5.3.5.2. Motion detectors are to be provided up to and including one level above ground level.

- 5.3.6. Control panel.
  - 5.3.7. Digital keypads.
  - 5.3.8. Battery back-up power supply to have a minimum rating of not less than 48 hours duration.
  - 5.3.9. Horns.
  - 5.3.10. I.P. compatible network card; provide a dedicated data outlet adjacent to the control panel for connection to the network card.
- 5.4. Intrusion alarm/access control system wiring shall incorporate as a minimum, CMR (FT-4) rated insulated copper conductors c/w "RED" coloured PVC outer jacket. Maximum length of cable drop between flush installed ceiling device box and associated junction box within same ceiling space, is not to be greater than 1520mm (5') unless specifically indicated otherwise. Minimum size 16mm (1/2") flexible metal conduit is permitted for drops (from above T- Bar ceilings) to various fire alarm devices installed upon flush mounted outlet boxes in finish ceiling tiles, etc. Maximum length of flexible conduit drop is not to exceed 4570mm (15') in total unless specifically indicated otherwise.
- 5.5. Provide digital keypads or card readers as required with adequate zones for bypass operation at each entrance.
- 5.6. Provide all equipment as required to monitor the intrusion alarm/access control system from an approved monitoring firm. Include the cost of monitoring for one year in the construction contract. The monitoring company shall be approved by the Minister's Representative before proceeding.
- 5.7. All intrusion alarm/access control panels are to be c/w tamper switch, lock and keys.
- 5.8. Intrusion alarm panel documentation to include all programming / contractor codes and passwords required for future modifications to the system.
- 5.9. Where the lighting control system permits, provide a latching output from the intrusion alarm system to activate general area lighting on alarm. This output is to unlatch when the intrusion alarm system is reset.
6. Video Surveillance (CCTV)
- 6.1. Provide a complete video surveillance system, including interior/exterior coverage of all entrances and circulation spaces as per the following:
    - 6.1.1. Signage is to be posted at all building entrances and driveway entrance(s) indicating that the premises are under video surveillance. The signage shall read:

Video Surveillance is in operation in this facility

Images are being recorded for the purposes of maintaining the security of the premises, the prevention and investigation of crime, health and safety of staff, visitors [students] and in the interest of good property management.

The video surveillance system is managed by [insert Department name here]

- 6.1.2. Provide on-line, double conversion, solid state, rack mounted UPS to feed all CCTV head end equipment and POE switches. UPS to be complete with surge suppression, power factor correction, rectifier, charger, inverter, batteries, and internal bypass. UPS shall operate during power outage for a minimum of 30 minutes. Minimum capacity to be 1800VA/1440W.
- 6.2. The basic system will consist of a complete functioning digital IP based security video system including:
  - 6.2.1. Cameras shall be (as a minimum) high-grade, commercial quality, fixed direction, color, high definition, progressive scan, network enabled, compact dome type. Cameras shall include rugged, high impact, vandal resistant, puncture proof domes and tamper resistant hardware.
    - 6.2.1.1. The selection of the video surveillance camera lens / imaging chip combination shall be based on the following ANSI / ESS Best Practices for the resolution of recorded images / video in the camera's Field Of View (FOV) as the minimum acceptable resolution:
      - 6.2.1.1.1. Observation: 65 pixels per meter (ppm) (20 pixels / foot (ppf))
      - 6.2.1.1.2. Forensic review: 131 pixels per meter (40 pixels / foot)
      - 6.2.1.1.3. Facial recognition: 262 pixels per meter (80 pixels / foot)
      - 6.2.1.1.4. License plate recognition: 197 pixels per meter (60+ pixels / foot)
    - 6.2.1.2. Key features, at a minimum shall include:

- 6.2.1.2.1. Image Sensor - 1/3.8 inch CMOS.
- 6.2.1.2.2. Active Pixels - 1280 (H), 720 (V).
- 6.2.1.2.3. Image Format - 720P HD
- 6.2.1.2.4. Minimum illumination 5 Lux.
- 6.2.1.2.5. Dynamic Range >50 dB.
- 6.2.1.2.6. Image Compression Method - MPEG-4 Part 10 H.264.
- 6.2.1.2.7. Image Rate - 30 fps at full resolution.
- 6.2.1.2.8. Motion detection - Selectable sensitivity and threshold.
- 6.2.1.2.9. Communications Standards Compliance - Open Network Video Interface Forum (ONVIF) Conformant, the camera shall support Profile S, Profile G, Profile Q and all other relevant profiles and specifications as published by the ONVIF organization.
- 6.2.1.2.10. Network interface 10/100 Base-T auto sensing half / full duplex via 8P8C modular jack.
- 6.2.1.2.11. Lens - Varifocal, auto iris. The variable focal length of the lens shall be coordinated with the active pixel size to provide a video resolution per the following as a minimum: License Plate Recognition requires 5 pixels/in. or 60 pixels/foot; Facial Recognition (visible and software based) requires 10 pixels/in. or 120 pixels/foot.
- 6.2.1.2.12. Cameras are to be capable of being remotely focused via software installed at the head end equipment location.
- 6.2.1.2.13. Power Supply: POE IEEE 802.3af compliant, 24 VDC
- 6.2.1.2.14. Vandal resistant dome enclosure. Camera mounting brackets at designated locations.
- 6.2.2. Provide Layer 2 and Layer 3 (as required), optical fibre (OM4) capable POE switches to IEEE standard 802.3af in each communications room servicing the area where video surveillance cameras are located. Switches shall be provided and installed in non-dedicated rack(s),
- 6.2.3. Embedded network recorder / server with built-in software to ensure compatibility with the camera system, and to maintain a minimum

- of a 14 day record of all cameras at a recording rate of 12IPS (per camera) in the base and future allocation of cameras.
- 6.2.4. The network recorder shall accept all Open Network Video Interface Forum (ONVIF) conformant cameras.
  - 6.2.5. The network recorder software shall be capable of the following as a minimum: motion detection, remote camera focus, and object masking.
  - 6.2.6. Provide licenses for all installed and future cameras in the design.
  - 6.2.7. Provide 5 licenses for remote viewing software to be installed and configured on owner supplied workstations.
- 6.3. The system will provide an external high level of clarity. The network recorder will allow copying of any video recording to a USB Memory stick, external hard drive or CD/DVD. Where cameras are located to provide identification of the subject, ensure the camera mounting height and location will provide the required field of view.
- 6.4. The network recorder / server for the video surveillance system will be located in a secure room, usually the main communications room.
- 6.5. Wiring:
- 6.5.1. All wiring shall be to the latest NS Government Structured Cabling Guidelines approved cabling, run to dedicated patch panels in the appropriate Communications room. Wiring shall be provided under the base building for the cameras installed, with a dual data outlet mounted in the accessible ceiling above each camera. A power source shall be provided in the accessible ceiling space at each exterior camera location.
  - 6.5.2. All cables shall be tested to the latest NS Government Structured Cabling Guidelines requirements, provide a verification report.
- 6.6. Verify correct operation of the system and provide manuals for all equipment.
- 6.7. Provide at least four hours instruction on use of the system upon completion and acceptance of the system. In addition, within 3 months of substantial completion, return to the site upon request of the Minister's Representative and readjust the aiming of the cameras as required and provide an additional 2 hours instruction in use of the system.
- 6.8. All video surveillance system component manufacturer default password(s) (cameras, servers etc.) are to be changed and the new password information is to be included in the O&M manuals. These new passwords are to follow US



Department of Commerce's National Institute of Standards and Technology (NIST) guidance on password best practices.

- 6.9. Video surveillance systems shall be equipped with user and host authentication functionality. It is to be confirmed in writing and included in the O&M manuals that this functionality has been configured.
- 6.10. All video surveillance system network configuration information (camera, server IP addresses etc.) is to be tabulated and included in the O&M manuals.

**Section 28 31 00 Fire Detection and Alarm**

1. Provide a complete fire alarm system as required by the Provincial Building Code as a minimum. Provide floor plans and a riser diagram on the drawings as required by CAN/ULC S-524.
2. All fire alarm systems are to be of the addressable type.
3. System shall include, but not necessarily be limited to the following:
  - 3.1 Fire Alarm Control Panel (FACP)
    - 3.1.1. Installed in a separate enclosure c/w an integrated (built-in) TVSS protected point for power source termination.
    - 3.1.2. Power supplies.
    - 3.1.3. LCD annunciator.
    - 3.1.4. Stand-by batteries.
    - 3.1.5. Central processor c/w microprocessor and logic interface.
    - 3.1.6. Main system memory.
    - 3.1.7. Input-output interfaces for alarm receiving, annunciation/display, and program
    - 3.1.8. control/signaling.
      - 3.1.8.1. Initiating/input circuits.
      - 3.1.8.2. Output circuits.
      - 3.1.8.3. Auxiliary circuits.
      - 3.1.8.4. Lamicoid nameplate is to be installed (with pop-rivets) on Control Cabinet cover indicating its designated power source c/w branch circuit breaker number (white lettering on red core).
      - 3.1.8.5. The fire alarm system control panel shall be capable of testing remote equipment (smoke and heat detection etc.) sensitivity at the control panel.
  - 3.2 Wiring:
    - 3.2.1. All wiring shall be in EMT conduit.
    - 3.2.2. Red armoured cable (bright red jacket over the exterior armour) shall be permitted for use in renovated areas.
    - 3.2.3. Minimum size 16mm (1/2") flexible metal conduit is permitted for drops (from above T-Bar ceilings) to various fire alarm devices installed upon flush mounted outlet boxes in finish ceiling tiles, etc.

Maximum length of flexible conduit drop is not to exceed 4570mm (15') in total.

- 3.2.4. Initiating circuit wiring and notification appliance wiring are to be segregated into separate raceway systems.
- 3.3 Manual and automatic initiating devices.
- 3.4 Audible signalling devices.
- 3.5 Visual signalling devices.
- 3.6 Locate the FACP in the main communications room and provide a remote active graphic annunciator at the fire fighters entrance.
- 3.7 Fire Door Holders are to be of the magnetic type, installed on walls behind doors at 450mm (18") A.F.F., and are to be supplied by the fire alarm system manufacturer.
- 3.8 End-of-line resistors where required.
- 3.9 LCD annunciator and active LED Graphic Annunciator at fire fighters entrance. The active LED Graphic Annunciator shall be comprised of (but not limited to) the following:
  - 3.9.1. Active graphic display(s) shall be printed on white photo bond paper in metal frame(s) with polycarbonate or Plexiglas glazing; the photo bond paper shall be mounted in such a manner as to be wrinkle and distortion free and be backed with polycarbonate or Plexiglas panels. The active graphic(s) shall be designed and fabricated and installed in a manner to render them easily modified, as well as damage and tamper resistant.
    - 3.9.1.1. The labeling on the graphic must closely correspond to the displays on the fire alarm annunciator LCD display. The floor plan drawing is to indicate:
      - 3.9.1.1.1. The building outline showing all exterior doors.
      - 3.9.1.1.2. The building's corridors, stairways and elevators.
      - 3.9.1.1.3. The location of, and divisions between, the fire alarm zones.
      - 3.9.1.1.4. The location of the main fire alarm panel (and annunciators where relevant).
      - 3.9.1.1.5. The location of the main sprinkler system valve and the supervised valve for each sprinkler zone. (Use of a legend and symbols is recommended). The initiating device locations and zone numbers, where relevant. (Use of a legend and symbols is recommended).

- 3.9.1.1.6. Kitchen fire suppression system, where relevant.
      - 3.9.1.1.7. An accurate "You are here" indicator.
    - 3.9.2. The active graphic display must be oriented to match the direction of the location at which it is to be posted, i.e; oriented to the direction in which the person viewing the display is facing.
    - 3.9.3. Solid state components, high intensity LEDs, provide one red led for each initiation device, and one amber LED for each trouble / supervisory alarm device.
  - 3.10 ULC monitoring service connection.
  - 3.11 Splices and T-taps shall not be permitted in the fire alarm system wiring, all wiring is to be run unbroken from device to device. Identify the incoming and outgoing conductors with self adhesive labels per 26 00 00.
- 4. Gas supplied equipment and air handling systems not involved in smoke control are to be shut down upon activation of a fire alarm. Air handlers are to automatically restart on fire alarm reset.
  - 4.1 Air handler shut down shall be accomplished by wiring an addressable fire alarm relay into the control circuit in such a manner that this air handler shutdown cannot be bypassed. Using the BAS as a means of shutting down the air handling systems is not acceptable.
- 5. New construction shall utilize combination horn/strobe signaling devices with a configurable "high" and "low" output. In addition, provide single strobes where conditions dictate their use. Combination horns and strobes, and/or single units of each, are to be located on finish "ceilings" unless a particular situation, i.e. high ceiling, open ceiling, etc., should dictate otherwise.
  - 5.1 Ceiling device boxes are to be supported directly from structure, and not under any circumstances to derive their support from T-Bar grid system.
  - 5.2 Ceiling device boxes are to be supported directly from auxiliary or intermediate pieces of dry-wall metal channels where installed in dry-wall type ceilings.
- 6. Provide a dedicated UL listed Fire Control Communicator (FCC) in order to allow remote monitoring from a ULC approved monitoring agency. Include the cost of monitoring for one year in the construction contract.
- 7. In addition to the latest edition NBC requirements, provide:
  - 7.1 Separately zoned thermal detectors in boiler rooms.
  - 7.2 Separately zoned smoke detectors in "all" electrical rooms and/or closets where panelboards are present.
  - 7.3 Separately zoned smoke detectors in elevator shafts.

8. If a deluge system is present, the fire alarm system shall be programmed so that it will only activate the deluge system when the associated smoke detectors are activated. NOTHING ELSE SHOULD BE CAPABLE OF ACTIVATING THE DELUGE SYSTEM.
9. The fire alarm system is to be verified to meet the requirements of CAN / ULC-S537 "Verification of Fire Alarm Systems". All associated, integrated systems are to be commissioned "as a whole", as part of the construction contract, in accordance with CAN/ULC-S1001, "Integrated Systems Testing of Fire Protection and Life Safety Systems," to ensure the proper operation and inter-relationship between the systems.

**END**

## DIVISION 31 - EARTHWORK

### Section 31 10 00      Clearing and Grubbing

1. Management of Grubbings
  - 1.1. Where on-site reuse is approved, ensure that the area is graded and landscaped to blend with other site features to the approval of the Province.
  - 1.2. The off-site disposal of grubbings will be at the discretion of the DPW Representative.
2. Management of Surplus Brush Slash or Non-Merchantable Timber
  - 2.1. Ensure the Contractor follows the Nova Scotia Department of Transportation and Infrastructure Renewal Highways Specification Division 1 Section 5, Environmental Protection for the management of brush, slash, or other non-merchantable timber.
  - 2.2. Mulch should be well aged shredded bark.
3. Chipping.
  - 3.1. Chips are to be disposed of where they will not wash into a watercourse or block ditches, culverts or drains.
  - 3.2. In accordance with best ecological practice, wood chips should be spread in wooded areas to create a neat, natural appearance, maximum depth of 100mm. If this is not feasible, wood chips should be removed from the site and disposed of in accordance with sustainability (LEED) requirements or other DPW approved of method.
  - 3.3. Dispose of unusable chip and slash at a licensed facility.
4. In all cases, disposal shall adhere to Federal, Provincial, and Municipal laws and regulations.
  - 4.1. Disposal in a municipal landfill is acceptable, if permitted by the Municipality.

**Section 31 20 00 Earth Moving**

1. Where Landscaping, Roads, Streets and Parking are incorporated into the design, complete design such that:
  - 1.1. The thickness of the foundation for paved areas is determined while considering the results of the geotechnical report recommendations, the properties of the foundation materials, the design vehicle type and frequency, and the pavement thickness.
  - 1.2. The grading of the aggregates is such that it shall allow sufficient draining of the foundation towards the storm drains while protecting against infiltration by fine subgrade materials.
  - 1.3. Effective grading of the area provides positive drainage away from the entire structure, particularly adjacent to foundation walls.
  - 1.4. Retention and use of existing site features and topography are maximized.
  - 1.5. Unless noted otherwise, all of the aggregate layers are compacted to 95% standard proctor density. Where required subgrade materials will be compacted in accordance with recommendations of the Geotechnical Report.
  - 1.6. Under slabs on grade, trenches, and sidewalks:
    - 1.6.1. Backfill is to be composed of granular material with non-capillary characteristics and compacted to 95% standard proctor density
    - 1.6.2. The layer of granular material has a thickness not less than 200 mm.
    - 1.6.3. When clay soil is in the area being backfilled, a 150 mm layer of sand or fine gravel, or specially made fabric filters are to be provided before the layer of granular material is placed. If a Geotechnical Report is available for the site, the recommendations of the Geotechnical Report are to be followed.
    - 1.6.4. Granular material is to be used for backfilling of the inside of the walls and pilasters.
  - 1.7. Where a highwater table is expected under slabs-on-grade below ground level, install a drainage system to avoid hydrostatic pressure under the slabs. The drainage system shall consist of perforated pipes draining to a storm sewer system, ditch, or watercourse under approval from the Nova Scotia Department of Environment. Embed and surround drainage system in a bed of Clear Stone granular material as defined in Division 3, section

4 of the Nova Scotia Standard Specification for Highway Construction and maintenance, and geotextile fabric. This system shall drain by gravity.

- 1.8. Remove topsoil from surfaces to be occupied by buildings, roads, walks and parking areas. Stockpile such soil for reuse in landscaping work.
- 1.9. The depth of excavations for foundation walls and pilasters shall conform to the requirements of the governing codes and regulations. When subject to freezing and thawing cycles, foundations shall not be less than 1.22 m below finished grade unless the Geotechnical Report or Municipal Standards require greater than 1.22 m of cover.
2. Mineralized Rock Excavation.
  - 2.1. When mineralized rock is encountered on the project, the "Sulphide Bearing Materials Disposal Regulations" made under Section 66 of the Environment Act are to be followed
3. Blasting
  - 3.1. All blasting is to be carried out in accordance with the regulations made pursuant to the Occupational Health and Safety Act, Chapter 320 of the Revised Statutes of Nova Scotia.
  - 3.2. The requirements as set out in the Occupational Health and Safety Act are deemed to be minimum requirements. Ensure the Contractor conducts his operations in a manner so as to comply with all other Act(s) or Regulations in effect at the time of the blasting.
  - 3.3. Blasting in or near watercourses is to receive prior approval from the Department of Fisheries and Oceans. Such blasting is to be in accordance with the Guidelines for use of Explosives in Canadian Fisheries Waters" (DFO; 1998).
  - 3.4. Blasting is to be done in a manner that the three components of ground vibration do not exceed 12.5 mm/sec (0.5 in./sec) and air concussion as measured by peak particle velocity shall not exceed 128 decibels (0.0003 lbs/sq. in.) as measured in the ground adjacent to the nearest structure where it is anticipated the values will be higher than at the nearest structure.



**Section 31 21 00      Off-Gassing Mitigation**

1. Where Phase 1 Environmental Site Assessment indicates a presence of Radon, TPH or other radioactive waste at contaminating levels, or as directed by the Department, provide for design and installation of a vapour extraction system. The system shall be designed as recommended by the Phase 1 Environmental Site Assessment or as directed by the Department and shall be designed by an Environmental Engineer.
  - 1.1. Where no evidence of TPH contamination is found provide vapour extraction system for potential TPH contamination under the boiler room only, of all buildings.
  - 1.2. Unless recommended by the Phase 1 Environmental Assessment, or directed by the Department, design a vapour extraction system for radon as a passive system with provision for future activation.

**Section 31 22 00      Grading**

1. The grading for paved areas shall be as indicated in Sections 32 10 00.
2. The grading of landscape areas shall be in accordance with the following:
  - 2.1. There shall be no standing water on the site except in areas designated to retain or infiltrate water.
  - 2.2. Minimum slope for landscaped areas (other than sports fields) shall be 2%.
  - 2.3. Minimum slope for ditches and swales shall be 1.5%.
  - 2.4. Maximum slope for turf areas shall be 1:4(rise: run). Slopes up to 1:2 (rise: run) are permitted provided maintenance is not required and safety issues are resolved, as approved by the Province.
  - 2.5. Sports fields shall be graded to meet the specific design requirements of each sport. Generally, the surface shall be sloped at minimum 1.5% to provide drainage.
  - 2.6. The surface of play areas around playground equipment shall be level, with drainage provided by subsurface means.
3. Topsoil and Finish Grading
  - 3.1. General:
    - 3.1.1. The Contractor shall provide all topsoil required to complete the work. This may include improved grubbing material stockpiled on-site, and topsoil imported from off site.
    - 3.1.2. Topsoil shall meet the requirements for its intended use and for the vegetation to be established according to the landscape plan.
    - 3.1.3. Source Quality Control
      - 3.1.3.1. Advise DPW of source of topsoil to be utilized 7 days in advance of starting work.
      - 3.1.3.2. Contractor is responsible for soil analysis and amendments to soil as specified.
    - 3.1.4. Testing
      - 3.1.4.1. All topsoil or other planting medium to be used in any project shall be tested for soil texture by an approved laboratory designated by the Province of Nova Scotia. Soil sampling, testing and analysis to be in accordance with provincial standards. Contractor will arrange and pay for cost of tests.

Contractor shall submit copies of Soils Texture Report to the Province for approval prior to delivery of soil to the site.

- 3.1.4.2. All topsoil or other planting medium to be used in any project shall be tested for fertility, organic matter sieve analysis, chemical analysis and pH value by an accredited Laboratory. Soil sampling, testing and analysis to be in accordance with provincial standards. Contractor will arrange and pay for cost of tests. Contractor shall submit copies of Soils Analysis Report to the Province for approval prior to delivery to the site and again prior to Acceptance.

## 3.2. Products

- 3.2.1. Topsoil or other planting medium to be used for any project to consist of material stripped from site (grubbings) and/or imported topsoil to be supplied by the Contractor with the following considerations:
- 3.2.1.1. Topsoil: mixture of mineral particulates, micro-organisms and organic matter which provides suitable medium for supporting intended plant growth.
  - 3.2.1.2. Soil Amendments: Lime, fertilizer and/or compost amendments to be made according to the fertility and pH requirements specified in the Soil Analysis Report.
  - 3.2.1.3. Topsoil to contain no toxic elements or growth inhibiting materials.
  - 3.2.1.4. Topsoil to be free from debris and stones over 25 mm diameter and coarse vegetative material, 12 mm diameter and 50 mm length, occupying more than 2% of soil volume.
  - 3.2.1.5. Topsoil consistence: friable when moist.
- 3.2.2. Planting Soil for Trees, Shrubs and Groundcover shall be as follows:
- 3.2.2.1. A mixture consisting of 7 - 8 parts topsoil, and 2 - 3 parts compost, manure, peat moss or decomposed ground bark.
  - 3.2.2.2. Soil Amendments to improve fertility and/or texture Peat moss: Derived from partially decomposed species of sphagnum mosses; elastic and homogeneous, brown in colour; free of wood and deleterious material which could prohibit growth; shredded particle minimum size: 5 mm.

- 3.2.2.3. Sand: washed course silica sand, medium to course textured.
- 3.2.2.4. Limestone: ground agricultural limestone containing minimum calcium carbonate equivalent of 85%; gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- 3.2.2.5. Fertilizer: complete, commercial, with 35% soluble nitrogen.
- 3.2.2.6. Manure: well-aged cattle manure, free of lumps and impurities.
- 3.2.2.7. Compost: shall meet provincial and CCME guidelines.

### 3.3. Execution

#### 3.3.1. Preparation of Subgrade

- 3.3.1.1. Verify that grades are correct. If discrepancies occur, notify DPW and do not commence work until instructed.
- 3.3.1.2. Grade soil, eliminating uneven areas and low spots to ensure positive drainage.
- 3.3.1.3. Remove debris, roots, branches, stones in excess of 25 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 50 mm above surface. Dispose of removed material at an approved site.
- 3.3.1.4. Coarse cultivate entire area which is to receive topsoil to depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading have compacted soil.

#### 3.3.2. Placing and Spreading of Topsoil/Planting Soil

- 3.3.2.1. Do not place topsoil until subgrade has been approved by DPW.
- 3.3.2.2. Spread topsoil in uniform layers not exceeding 150 mm, over unfrozen sub-grade free of standing water.
- 3.3.2.3. Spread topsoil over areas to be seeded to a minimum depth of 150 mm after settlement and 80% compaction.
- 3.3.2.4. Place planting soil in shrub planting beds and pits to a minimum depth of 450 mm after settlement.

3.3.2.5. Manually spread topsoil/planting soil around trees, shrubs and landscape features.

3.3.3. Soil Amendments

3.3.3.1. Apply and thoroughly mix soil amendments and fertilizer into full depth of soil at rates recommended by Soils Analysis Report or qualified Vegetation Consultant.

3.3.4. Finish Grading

3.3.4.1. Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

3.3.4.2. Consolidate topsoil to leave surfaces smooth, uniform and firm against deep foot printing.

3.3.5. Acceptance

3.3.5.1. DPW will inspect materials in place and determine acceptance of material, depth of topsoil and finish grading. Approval of topsoil material subject to soil testing and analysis.

3.3.5.2. Restoration of Stockpile Sites: Restore stockpile sites acceptable to DPW

3.3.5.3. Surplus Material: Dispose of materials not required at approved site.

**Section 31 30 00 Earthwork Methods**

1. Tests and Inspections
  - 1.1. Ensure that backfilling or filling operations do not begin until backfill material has been approved for use by DPW.
  - 1.2. A minimum of 48 hours prior to commencement of backfilling or filling, ensure that DPW is notified such that compaction testing can be carried out by the designated testing agency.
2. Performance
  - 2.1. Ensure all aspects of earthwork, including excavating, trenching and backfilling, are performed according to guidance in the Geotechnical Investigation report, and to the satisfaction of the Province. Ensure Geotechnical Engineer provides written confirmation of acceptance.

**END**

## **DIVISION 32 - EXTERIOR IMPROVEMENTS**

### **Section 32 00 00 Exterior Improvements - General**

1. Refer also to DC350, Part 1, Section 1, Item 4 Site Planning for related site improvements requirements for design and construction.

**Section 32 10 00      Bases, Ballasts, and Paving**

1. Asphalt Paving

1.1. Quality Assurance Requirements for Drawings and Specifications:

- 1.1.1. The materials, mixes, compacting and laying of pavement shall conform to the specifications set out by the DPW Standard Specification Highway Construction & Maintenance, Division 4 - Pavements.
- 1.1.2. When requested, obtain and submit certificates from the asphalt supplier attesting that materials comply with specifications.
- 1.1.3. Submit affidavits that fill materials placed under Work of this Section have been compacted to specified density and approved by the Materials Testing or Geotechnical consultant.
- 1.1.4. Provide asphalt concrete inspection reports based on CSA standards and the Nova Scotia DPW Standard Specification Highway Construction and Maintenance, latest edition.
- 1.1.5. Remove and replace all asphalt not conforming to the above requirement, at no cost to the Province.

1.2. Where Asphalt Paving is incorporated into the design:

- 1.2.1. Apply asphalt paving to all the parking areas, in addition to the access lanes and loading areas.
- 1.2.2. The surface of asphalt pavement shall be graded to meet the following:
  - 1.2.2.1. In no case shall the cross slope or finish profile of the finished pavement be less than 2%. This slope is to discourage ponding or occurrence of surface icing.
  - 1.2.2.2. The slope of driveways shall not exceed 6 % slope.
  - 1.2.2.3. The slope of parking areas shall not exceed 5 % slope.
  - 1.2.2.4. Barrier-free parking areas shall have a slope of 2%.
- 1.2.3. The thickness of the asphalt pavement shall be as recommended in the Geotechnical Report or if not specified shall be 63mm minimum in areas used by light traffic (vehicles of 1 ton or less) and 75mm minimum for areas used by vehicles heavier than 1 ton.
- 1.2.4. Surface Drainage



- 1.2.4.1. Slope surface of pavement to stormwater management devices unless a municipal storm drainage systems exist.
- 1.2.4.2. Where such municipal storm drainage system exists, receive approval from the owner of the storm sewer to connect to the system. Connect to that system using methods approved by the sewer system owner.
- 1.2.4.3. Storm water management of project sites is to comply with the more stringent of NSE guidelines or local Municipal storm water balancing requirements.
- 1.2.5. Line Painting
  - 1.2.5.1. Two coats of line marking paint 100 mm wide are required for parking stall lines.
  - 1.2.5.2. Crosswalk markings and barrier free symbols for designated parking stalls to be included in specifications and on design drawings.

**Section 32 16 00      Curbs, Gutters, Sidewalks, and Driveways**

1. All walkways and curbs shall be Portland cement concrete or asphaltic concrete as required by DPW; granular walkways are not permitted.
2. All walkways shall be barrier free. Slopes shall not exceed specifications provided in CSA B651-18 Barrier Free Design or Nova Scotia Building Code section on Barrier Free Design, whichever is more stringent.
3. Provide depressed curbs:
  - 3.1. At driveways to allow vehicles to pass.
  - 3.2. As required to provide barrier-free access.
4. Where curbs are adjacent to a sidewalk, they shall be monolithic or thickened edge design.
5. Expansion joints shall be built at right angles to the sidewalk.
6. The expansion joints shall be made of 12mm asphalt felt placed at intervals not to exceed 15.0 metres and at critical locations adjacent to other features such as utility poles, fire hydrants, walls and drains to prevent the uncontrolled cracking of the paved surface.
7. The surfaces of concrete sidewalks and curbs shall have a broom finish perpendicular to the edges. The surface shall be non-slip.
8. Sidewalks shall be constructed to ensure a transverse slope not less than 2.0%, but not more than is acceptable by CSA B651-18.
9. After finishing, polishing and clean-up of edges, cure in accordance with CSA A23.1-14/A23.2-14.

**Section 32 17 00      Paving Specialties (Pavement Markings)**

1. Provide for painted pavement markings to requirements of the Department of Transportation and Infrastructure Renewal and the local municipal authority. Identify and control traffic movement on site; including, but not limited to, sidewalks, bus entrances, car parking and service entrances.

**Section 32 30 00      Site Improvements**

1. Fences and Gates:

- 1.1. Fences and gates are to be sized to accommodate the proposed use and shall include person gates, vehicle gates, height requirements and material based on the intended use.
- 1.2. Fences and gates require submission of shop drawings and approval from DPW prior to ordering of materials.

2. Retaining Walls:

- 1.3. Design drawings are to include grades, elevations, length and width of proposed retaining walls. Proprietary walls are to be designed by the manufacturer and stamped design drawings are to be submitted for review.

**Section 32 90 00      Planting**

1. Planting Plan is to be prepared by landscape architect and submitted with the project design and tender documentation.
  - 1.1. Where a specific list of approved plants is provided in the Project Program or other Contract Document, the use of alternate plant material shall only be considered when the Contractor has demonstrated that they have exhausted all possible sources. These alternatives must be approved by the landscape Architect Consultant on behalf of DPW.
2. Plant trees, shrubs and ground covers in accordance with the Canadian Standards for Nursery Stock latest Edition of the Canadian Nursery Landscape Association.
3. Assure plant materials for landscape development are suitable for the locality, using native plant species material where practical.
4. Do not plant under building overhangs or within 900 mm of foundations.
5. The Contractor shall warrant that plant material will remain free of defects for 1 full growing season, following date of Acceptance.
6. The Contractor shall perform the following maintenance operations during the warranty period.
  - 6.1. Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion. For evergreen plant material, water thoroughly in late fall prior to freeze-up to saturate soil around root system.
  - 6.2. Remove weeds monthly.
  - 6.3. Replace or re-spread damaged, missing or disturbed mulch.
  - 6.4. For non-mulched areas, cultivate and remove weeds monthly.
  - 6.5. Apply fertilizer in early spring at manufacturer's suggested rate.
  - 6.6. Avoid use of pesticides. When required to control insects, fungus or disease, apply pesticides only with approval from DPW and in accordance with Federal, Provincial and Municipal regulations.
  - 6.7. Remove dead or broken branches from plant material.
  - 6.8. Keep trunk protection and guy wires in proper repair and adjustment.
  - 6.9. Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.
  - 6.10. Remove trunk protection, tree supports and level watering saucers at end of first growing season.

**Section 32 92 00 Turf and Grasses**

1. Maintenance is to include but not to be limited to: watering, fertilizing, mowing, aerating.
2. Maintain seeded and sodded area from date of Acceptance until end of Warranty Period.
3. Deficiencies are defined as results from all operations during construction and/or maintenance that become apparent at any time before end of Warranty Period and do not conform with the required level of quality.
  - 3.1. All deficiencies shall be corrected in a timely fashion.
4. Reference Standards
  - 4.1. Canadian Nursery Trades Association; Canadian Standards for Nursery Stock, latest edition.
5. Samples
  - 5.1. Inform Consultant of proposed source of sod to be supplied and provide access for sampling. Do not commence work prior to approval of sod. Submit samples in accordance with the requirements of this and related specifications and as directed by DPW.
  - 5.2. Provide product data for: Seed, fertilizer and soil amendments.
6. Quality Control
  - 6.1. Obtain approval of sod from the Consultant prior to sod laying.
  - 6.2. Obtain approval of sod roller from Consultant.
  - 6.3. Inspection and testing of sod will be carried out by the Consultant.
  - 6.4. Obtain approval of sod installation from the Consultant prior to starting maintenance period.
  - 6.5. Obtain approval of watering operation from the Consultant during Maintenance Period.
7. Scheduling:
  - 7.1. Seed between May 15 -June 15, or between August 15 and September 15.
  - 7.2. Seeding is not to be undertaken outside of the periods specified above. Contractor must be prepared to irrigate to maintain moisture until seeded mixture is well established.
  - 7.3. Sod may be laid any time from April until December. Sod should not be laid during hot/dry weather without irrigation or some other means of assuring the roots are in contact with moist soil

8. Warranty

- 8.1. Provide warranty for general field construction for a one-year maintenance period starting at date of Acceptance.
- 8.2. All lawns shall remain free of defects for 1 full growing season, commencing at date of Acceptance.
  - 8.2.1. A growing season shall be from May 1 - Oct. 31.
- 8.3. All seeded and sodded areas shall be warrantied and maintained for a period of one year following the date of Acceptance.
- 8.4. Warranty shall be extended if development and growth is not sufficient to ensure future survival as determined by DPW.

9. Materials:

9.1. Grass Seed

- 9.1.1. Canada "Certified" seed, in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".
- 9.1.2. Use seed mix approved for specific end use of area to be seeded.
  - 9.1.2.1. "Canada No. 1 Lawn Grass Mixture" for lawns and other areas to consist of Creeping Red Fescue, Kentucky or Canada Bluegrass and Annual Rye in an approved mixture, or at the recommendations of a Turf Specialist approved by DPW.
  - 9.1.2.2. Canada No. 1 Grass seed mixture for sports field to contain 3 compatible varieties of Kentucky Bluegrass and this mixture is to be approved by DPW.
  - 9.1.2.3. For reclamation sites, the Nova Scotia Highway Seed Mix may be used, or other reclamation mixture recommended by a Reclamation Specialist.
  - 9.1.2.4. In packages individually labeled in accordance with "Seeds Regulations" and indicating name and supplier and date bagged.

9.2. Sod:

- 9.2.1. Nursery Sod: quality and nursery source to comply with standards outlined in latest edition published by Canada Nursery Trades Association.
- 9.2.2. The sod shall be strongly rooted and free of noxious weeds, undesirable plants, roots, stones, and other foreign materials that will be detrimental or will hinder the proper development of the sod.

It shall be cut from living, thickly matted turf and shall be mowed to a height not to exceed 50 - 70 mm and thoroughly watered before the sod is cut.

- 9.2.3. Sod for areas other than sports fields shall be field sod containing a biodiverse mixture of a minimum of five native and/or naturalized species containing grasses, wildflowers and other herbaceous plants known to thrive in the local area. Field sod must be free of diseased plants, pest infestations and noxious or invasive species as listed in the "Nova Scotia Weed Control Act" (e.g. Purple loosestrife, Japanese knotweed, sweet clover, coltsfoot, woundwort)
- 9.2.4. Sod for sports fields shall be 100% No. 1 Kentucky Bluegrass sod containing 3 compatible varieties. Cut and deliver in large rolls.
- 9.2.5. Sod shall be free of clover and weeds, with no surface soil visible when mowed to a height of 38 mm (1.5 inches). It must be well rooted, free from burnt or bare spots.
- 9.2.6. Soil portion shall be of uniform thickness, not to exceed 1.9 cm (0.8 in) thick, and to Section 17 of the Canadian Standards for Nursery Stock.
  - 9.2.6.1. The use of sod in the following areas is an absolute requirement:
    - 9.2.6.1.1. Areas which require immediate and permanent vegetation cover, such as:
      - 9.2.6.1.1.1. waterways and channels carrying intermittent flow at acceptable velocities
      - 9.2.6.1.1.2. areas around drop inlets when the drainage area has been stabilized,
      - 9.2.6.1.1.3. steep critical areas,
      - 9.2.6.1.1.4. under the face of buildings,
      - 9.2.6.1.1.5. lawn areas as determined by DPW.
- 9.2.7. Documentation of the source of the sod and verification of species used in the sod shall be submitted to DPW.
- 9.2.8. Care shall be exercised at all times to retain soil on the sod roots during transportation, handling and planting. The sod shall be transported to the site within twenty-four (24) hours from the time it is cut, unless it can be stored to the satisfaction of the Project Engineer. During delivery and while in stacks or rolls, all sod shall be



kept moist and protected from exposure to the wind, sun and freezing. All damaged or dry sod shall be rejected.

9.3. Water

9.3.1. Free of impurities that would inhibit germination and growth.

9.3.2. Supplied by Contractor.

9.4. Fertilizer

9.4.1. To Canada "Fertilizers Act" and "Fertilizers Regulations".

9.4.2. Complete synthetic, slow release with 35% of nitrogen content in water insoluble form.

9.5. Organic Binder or Tackifier

9.5.1. Binder or Tackifier acts as an adhesive to bind soil, fiber and seed particles together and to temporarily control the effects of wind and water erosion during seed germination and plant establishment.

9.5.2. May be supplied in liquid or powder form and shall be applied at the Manufacturer's recommended application rate. It shall not contain any toxic or growth inhibiting chemicals or compounds.

9.6. Hydraulic Mulch

9.6.1. Hydraulic mulch is specifically manufactured for use in hydraulic seeding equipment.

9.6.2. It shall be locally procured, non-toxic, water activated, green in colour, and free of germination and growth inhibiting factors. Requests to use products not locally produced shall be submitted to DPW for approval before use.

9.7. Organic Amendments, including compost, to enhance germination or growth may be used at the discretion of DPW.

9.8. Herbicide

9.8.1. No herbicide shall be used.

9.9. Accessories

9.9.1. Pegs: wood, 25mm x 25mm x 200mm nominal size, wood lathes or equivalent as approved by the Consultant.

10. Execution

10.1. Delivery and Storage of Sod:

10.1.1. Schedule deliveries of sod to coincide with end of topsoil installation and approval of Work to minimize storage at job site.

- 10.1.2. Deliver, unload and store sod on pallets.
- 10.1.3. Protect sod against damage during delivery and transportation.
- 10.1.4. Protect the sod when on site to prevent the drying of the sod or rain washout.
- 10.2. Workmanship
  - 10.2.1. Work is not to be undertaken under adverse field conditions such as frozen soil, excessively wet or dry soil or soil covered with snow, ice or standing water.
- 10.3. Seed or Sod Bed Preparation
  - 10.3.1. Verify that grades are correct. If discrepancies occur, notify Project Manager and do not commence work until instructed. For sports fields, provide a topographic survey to confirm finish elevations and depth of the installed topsoil.
  - 10.3.2. Fine grade surface free of humps and hollows to smooth, even grade, to elevations indicated, to tolerance of plus or minus 15 mm, surface draining naturally.
  - 10.3.3. Cultivate fine grade approved by Project Manager to 25 mm depth immediately prior to seeding.
  - 10.3.4. Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; at an approved site.
  - 10.3.5. If seeding using a mechanical seeder or when sodding, work fertilizer and lime at rates recommended by the Soil Analysis Report, into the top few centimeters of soil prior to seeding or laying sod.
- 10.4. Turf Establishment, Mechanical Seeding
  - 10.4.1. Hydraulic seeding is permitted only in areas difficult to access and not intended for recreational use such as at the perimeter of a site, or slopes and areas that are not intended to be maintained. Permission for hydraulic seeding shall be approved by DPW.
  - 10.4.2. Use a single operation mechanical landscape seeder such as "Brillion" type which accurately places seed at specified depth and rate and rolls surface.
  - 10.4.3. On cultivated surfaces, sow seed uniformly at rate of 1.0 kg/22.5 sq metres along with appropriate proportion of water and fertilizer.
  - 10.4.4. Blend applications 150 mm into adjacent grass areas to form uniform surfaces.

- 10.4.5. Sow half of required amount of seed in one direction and remainder at right angles.
- 10.4.6. Embed seed into soil to depth of 10 mm. Not less than 85% of seed to be placed at specified depth and covered by soil.
- 10.4.7. Immediately after seeding, use agricultural, water ballast type roller, not less than 500 mm diameter with smooth steel drum and a width not less than the width of the landscape seeder to mechanically consolidate the seeded area if soil conditions warrant or if directed by DPW.
- 10.4.8. Water with fine spray to avoid seed wash-out. Water to ensure penetration of minimum 50 mm.
- 10.4.9. Protect seeded areas against damage. Remove this protection after lawn areas have been accepted.
- 10.5. Turf Establishment, Hydraulic Seeding
  - 10.5.1. Thoroughly mix the specified seed mixture, recommended fertilizer, lime if needed, hydraulic mulch and tackifier with water and apply with an approved hydraulic seeder.
  - 10.5.2. Seed mix at rate of 100 kg/ha
  - 10.5.3. Fertilizer at recommended formulation at rate of 625 kg/ha
  - 10.5.4. Hydraulic mulch shall be mixed in a hydroseeding unit with the other ingredients and sprayed evenly and uniformly over the designated areas at a rate of 2200 kg/ha +/- 10%.
  - 10.5.5. Hydroseed during calm wind conditions. Re-apply where application is not uniform.
  - 10.5.6. Remove slurry from areas not designated to be sprayed.
- 10.6. Turf Establishment, Sodding:
  - 10.6.1. Sod delivered to the site shall not be dried out nor frozen. Sod shall not be dumped from vehicles, nor shall it be handled with pitch forks.
  - 10.6.2. Sod should be placed as soon as possible after the ground surface has been graded, to take advantage of the ground moisture.
  - 10.6.3. Sod shall not be applied on frozen ground. The sod bed shall be moist prior to laying the sod. Lay sod as soon as possible after lifting to ensure proper establishment.
  - 10.6.4. Roll or fold sod prior to lifting and handled in proper manner as to avoid stretching, tearing or breaking of sod and root mass.

- 10.6.5. Place sod in rows, perpendicular to slope, smooth and even with adjoining areas, and with joints staggered. Butt sections closely without overlapping or leaving gaps. Trim excess, irregular or thin sections with sharp knife, edger or equivalent. Do not tear sod.
  - 10.6.6. Discard plastic mesh that support sod rolls; do not leave under sod as sod is laid on the field.
  - 10.6.7. Replace any damaged sod by a well cut properly fitting piece of sod.
  - 10.6.8. Throughout work, verify the quality of compaction of soil and correct according to field requirements before laying sod.
  - 10.6.9. Roll sod with light weight roller immediately after placement of sod.
  - 10.6.10. Water sods immediately after laying and rolling to obtain moisture penetration through sod into top 100mm (4 inches) of topsoil.
  - 10.6.11. Obtain Substantial Performance of Work from Consultant prior to commencing Maintenance period.
- 10.7. Turf Establishment, Sodding
- 10.7.1. The sod shall be applied by hand in rows at right angles to the direction of slopes, starting at the base of the area to be sodded and working upward. The strips shall be laid together tightly so that no open joints are left between strips or between the ends of strips. The joints shall be staggered between the ends of strips. The edges of the sod at the top of the slopes shall be tucked slightly under. A layer of soil shall be compacted over the edge to conduct surface water over and onto the top of the sod.
  - 10.7.2. Sod shall be laid perpendicular to the flow of water on slopes and in ditches and waterways.
  - 10.7.3. The sod shall be firmly tamped or rolled immediately after it is placed to eliminate all air pockets and to provide a smooth, even surface.
  - 10.7.4. Immediately after rolling or tamping the sod, sufficient water will be applied to completely saturate the sod.
  - 10.7.5. All excess earth, stones or other debris shall be removed by the Contractor when sodding is completed.
  - 10.7.6. Sodding at face of building: Sod to a distance from the face of building minimum distance of 7 m with the balance of the site seeded, unless required otherwise by the program. Water run-off from the building will be directed away from any sodded areas around building perimeter.

- 10.8. Maintenance During Establishment Period: perform following operations from time of seed and sod application until acceptance by DPW:
  - 10.8.1. Water seeded and sodded areas with fine spray to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.
  - 10.8.2. At the Contractor's expense, any sod which shows signs of settlement shall be cut out and replaced.
  - 10.8.3. Dead or bare spots shall be repaired and re-sodded or re-seeded, as approved by DPW, to allow establishment of turf prior to acceptance.
  - 10.8.4. For lawns and other manicured areas cut grass to 50 mm whenever it reaches height of 75 mm.
  - 10.8.5. Fertilize seeded and sodded areas after first cutting in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water it well.
  - 10.8.6. Eliminate weeds by means approved by DPW.
- 10.9. Maintenance: General Requirements
  - 10.9.1. Site Conditions:
    - 10.9.1.1. Avoid maintenance operations after a heavy rain when soil is wet. Do not mow when turf is wet.
  - 10.9.2. Machinery:
    - 10.9.2.1. All machinery will be equipped with turf tires and will be designed to specifically perform the intended operation.
    - 10.9.2.2. Maintain mowing blades well sharpened and free of rust and abrasions.
  - 10.9.3. Watering:
    - 10.9.3.1. Water sodded areas throughout the maintenance period in sufficient quantity and at frequency required to maintain an appropriate level of moisture through sod into topsoil to a minimum penetration of 100mm.
    - 10.9.3.2. Watering to be done between 7:00a.m. and 10:00a.m., and 4:00p.m. and 10:00p.m., and using best horticultural practice.
    - 10.9.3.3. The Contractor shall notify the Consultant at least 12 hours before scheduled watering operation.
  - 10.9.4. Mowing:

- 10.9.4.1. Mow sodded areas throughout the growing season, to maintain the turf between 70 mm to 90 mm (2.75 to 3.5 inches). Never mow any more than one third of the length of the leaf at one time.
- 10.9.4.2. Mowing operations will be done in cross mode.
- 10.9.4.3. Mowing shall be done with well maintained, sharp blades, free of rust and abrasions.

#### 10.10. Fertilizing Program

##### 10.10.1. Seeded areas:

- 10.10.1.1. To minimize environmental impact, the application of fertilizer is to be based on the soil chemistry as recommended in the soil analysis report. If no report exists (such as for smaller projects) apply a general fall lawn fertilizer in the fall of the year following the seeding of the lawn areas.
- 10.10.1.2. In the following spring, apply an application of 6-12-12 fertilizer at the recommended rate to all areas seeded the year before.

##### 10.10.2. Sodded areas:

- 10.10.2.1. Fertilize sodded areas one month after finish sodding. Do three applications of nitrogen during the growing season, one in spring, one early summer and one in late summer, and starting one month after sod installation, at the rate of 0.25 lbs (0.007 kg) N/1000sq.ft per application.
- 10.10.2.2. When Maintenance Period starts at end of the growing season, postpone fertilization with high nitrogen content until the beginning of the next growing season and replace with a high potassium slow-release fertilizer. Resume application of nitrogen fertilizer at the beginning of the next growing season.
- 10.10.2.3. Monitor the rate of fertilizer application and the ratio with Consultant for optimum growth.

10.10.3. Aeration:

10.10.3.1. Provide two aeration operations to non irrigated field during the maintenance period according to the following construction period:

10.10.3.1.1. Spring construction: Aerate the field once in early September and in accordance with the Consultant.

10.10.3.1.2. Autumn construction: Aerate the field in the following spring, one time as soon as the field moisture is at field capacity,

10.10.3.1.3. The second aeration operation will coincide with Final Acceptance of the Work.

10.10.3.1.4. Aeration operation will be done with slicer aerator equipped with 6 inch tines. Each operation shall consist of one time passing lengthwise and one time passing on the width of the field.

10.10.3.1.5. The 6 inch tines shall fully penetrate into the soil in all areas of the field for acceptance of the Work. Notify the Consultant 24 hours prior to aeration operation. Timing of field aeration will be coordinated with the Consultant.

10.10.4. Control of weeds, diseases and insect:

10.10.4.1. Maintain sodded areas weed, insect and disease free through proper cultural and maintenance practice including but not limited to aeration, watering, pH control, fertilization, proper mowing practice, over seeding and control of grass coverage thickness.

10.10.4.2. Any application of pesticide will be performed in accordance with federal, provincial and municipal regulations as and when required to control insects, fungus and diseases and shall be approved by the Consultant.

10.10.5. Acceptance:

10.10.5.1. The Work will be accepted by the Consultant at the end of the Establishment Period provided that:

- 10.10.5.1.1. Root zone is properly established and penetrates into the topsoil layer to a depth sufficient to support a vigorous turf growth.
  - 10.10.5.1.2. Turf is growing vigorously, without disease and insect infestation, areas are uniformly established and turf is healthy, dark green and free of rutted, eroded, bare or dead spots and free of weeds, with a thick carpet where when mowed at 6cm (2.5 inches) high, no soil is visible.
  - 10.10.5.1.3. Surface is even and without depressions.
  - 10.10.5.1.4. Gradients meet specifications.
  - 10.10.5.1.5. That a 6-inch tine aerator will penetrate to its full depth into the soil and in all areas in the field, without adding extra weight to the aerator, and when soil is at field capacity.
  - 10.10.5.1.6. Lawn areas have been cut at least twice.
  - 10.10.5.1.7. All seeded and sodded areas have been fertilized.
- 10.11. Maintenance During Warranty Period. Perform following operations from date of Acceptance until end of Warranty Period.
- 10.11.1. Repair and re-sod / reseed dead or bare spots to satisfaction of DPW.
  - 10.11.2. Fertilize seeded areas in accordance with fertilizing program. On lawn areas, spread half of required amount of fertilizer in one direction and remainder at right angles and water it well.
  - 10.11.3. Eliminate weeds by means approved by DPW.
  - 10.11.4. Regular cutting of the lawn areas is to be undertaken during the Warranty period.
  - 10.11.5. Sodded sports fields are to be aerated at approved sequenced intervals during the warranty period.

**END**



## DIVISION 33 - UTILITIES

### Section 33 05 00 Common Work Results for Utilities

1. Specify Pipe Laying to include the following:
  - 1.1. Handle, lay, bed, join and cover pipes carefully and in such a manner as to preclude any possibility of damage thereto.
  - 1.2. Lay and join pipes in strict accordance with written manufacturer's instructions and generally as follows:
    - 1.2.1. In straight lines and to required even grades
    - 1.2.2. Clean pipe thoroughly before laying. Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary water-tight heads when pipe laying in not in progress.
    - 1.2.3. Provide suitable pockets for the bells and coupling of pipe, so that the total length of the bottom segment of the pipe barrel is evenly and firmly supported.
    - 1.2.4. Where pipes enter or leave manholes or other structure, support them on compacted crushed stone bed or concrete cradle through the backfilled area. The pipe support shall extend laterally from undisturbed soil to the face of the wall through which the pipes pass.
  - 1.3. Face bell ends of water pipe in direction of laying. On grades of 5% or greater lay pipe up grade. Do not exceed maximum joint deflection recommended by manufacturer. Deflect only after joint is completed.
  - 1.4. Ensure concrete pipe is installed in accordance with AWWA M9 2008 manual for concrete pipe installation.
  - 1.5. Form concrete benching in manholes to provide a smooth unobstructed flow channel in the bottom of manhole with slopes of 8%.
  - 1.6. Test pipes as required by authorities having jurisdiction.
  - 1.7. Flush and disinfect water mains to AWWA C651-14

**Section 33 10 00      Water Utilities**

1. Reference Standards
  - 1.1 Halifax Water Design and Construction Specifications and Drawings
  - 1.2 Standard specification for Municipal Services - NSRBA and NSCEA
  - 1.3 Halifax Regional Municipality Red Book or Local Municipal Standards
  - 1.4 Nova Scotia Environment Regulations
  - 1.5 Environment Act of Nova Scotia
2. General
  - 2.1 Shop Drawings
    - 2.1.1 Submit shop drawings in accordance with SECTION 01 10 00 for all pipe, fittings, valves and all other items necessary for a complete water main installation.
  - 2.2 Certificates
    - 2.2.1 Submit manufacturer's test data and certification that products and materials meet the requirements of the specifications and drawings.
  - 2.3 Materials
    - 2.3.1 Diameter, material and strength class of pipe and fittings: as indicated
    - 2.3.2 Any material that comes in contact with drinking water must comply with NSF 61.
    - 2.3.3 Store materials to prevent retention of water and damage by freezing.
3. Municipal service may be available but may not have sufficient pressure for sprinkler systems of the building. Review availability of such service and incorporation into design with the Department's project team coordinator. Otherwise, confirm that adequate pressure and water volume for both the building's sprinkler system and domestic water system are available.

**Section 33 20 00      Wells**

1. Ensure appropriate drilling and testing are carried out prior to commencing design.
  - 1.1 Well is to be constructed in accordance with the Nova Scotia Well Construction Regulations (Sections 66 and 110 of the Environment Act).
2. Ensure chemical analysis and 72-hour flow test are performed on each drilled well associated with the project. Ensure that, as well as the standard suite of chemical parameters, the analysis includes arsenic, uranium and radioactive lead - 210.
3. Ensure well provides water a minimum rate sufficient for the size of the project as per the engineer's design, without exceeding the approved short-term or long-term safe yield, as determined during the 72-hour pump test.
4. Well cap and casing to be protected from vehicular traffic and from vandalism.
5. Well water system to be flushed and disinfected. Testing and provision of total and fecal coliform, bacteria counts, in compliance with Canadian Drinking Water Quality Guidelines for 3 days in a row must be provided prior to acceptance.
6. Provide concrete filled steel bollard protection on all sides of well cap. The well cap must be protected from damage by vehicles, including snow removal and turf maintenance equipment. The well cap shall be surrounded by bollards with an open space not to exceed 1500 mm. The bollards shall be durable and permanent in construction such as 150 mm diameter, galvanized steel pipe filled with concrete, or approved equal. The bollards shall be 1.0 m in height above finished grade, painted bright yellow for good visibility, and installed to a depth of 1.0 m in a 300 mm diameter concrete foundation.
7. Do not disturb well cap or casing. Should any damage to the water well occur during construction, this damage shall be repaired, or a new water well provided by the Contractor at his / her own expense, to the approval of the Province. Wells must be installed by a licensed well installer as regulated under the Nova Scotia Environment Act.
8. Provide manholes with lockable covers over top of dug well.

## **Section 33 30 00 Sanitary Sewage Utilities**

1. Reference Standards
  - 1.1 Halifax Regional Municipality, Red Book
  - 1.2 Halifax Water Design and Construction Specifications and Drawings
  - 1.3 Standard specification for Municipal Services - (NSRBA and NSCEA)
  - 1.4 NSE Technical Guidelines for On Site Sewage Disposal
  - 1.5 Atlantic Canada Wastewater Design Guidelines
2. Materials
  - 2.1 Sewage Piping
    - 2.1.1 Diameter, material and strength class of pipe and fittings: as indicated.
3. Provide, where on-site sewage disposal is part of the design requirement, engineering design services by a qualified Professional Engineering Consultant having demonstrable expertise in large scale on site sewage disposal system design. On-site sewage disposal also includes options using treatment by advanced on-site sewage treatment technologies approved for use in Nova Scotia by NSE.
4. Where central services are not immediately available, develop the property in such a manner that an acceptable location for the on-site sewage disposal system is protected from traffic.
5. Install on-site sewage disposal systems in accordance with the Regulations Respecting On- site Sewage Disposal, the Nova Scotia Department of the Environment policies under the Environment Act, and any conditions included with the Approval to install the system.

## Section 33 40 00 Storm Drainage Utilities

1. Reference Standards:
  - 1.1. Nova Scotia Department of Environment and Labour Handbook for Sedimentation and Erosion Control.
  - 1.2. Standard Specification for Municipal Services (NSRBA and NSCSA)
  - 1.3. Halifax Regional Municipality, Red Book
  - 1.4. Halifax Water Design and Construction Specifications and Drawings
  - 1.5. Nova Scotia Environment Regulations
  - 1.6. Environment Act of Nova Scotia
2. Naturalized drainage areas shall be retained whenever possible and protected from construction activities.
3. All site designs for Provincial Buildings are required to approach, as much as possible, a “balanced design” for storm water management including pre and post development runoff rates, volumes and water quality. This includes efforts to match pre and post development runoff hydrographs, not only peak flow. Adherence to local Municipal requirements for pre and post development balancing is required.
4. Provide adequate management of surface water drainage.
5. Address retention, detention and drainage of stormwater from roofs, driveways, parking lots and landscaped areas in a manner that does not adversely affect neighboring sites or existing watercourses. Consider stormwater detention through detention ponds, existing wetlands, bioswales, vegetated swales, or sub-surface storm water detention systems. Where detention ponds are provided in the design, area is to be enclosed by appropriate fencing complete with vehicle access gates.
6. Use vegetation adapted to expected hydrologic conditions to improve run off reduction and water quality. Use native plant species whenever possible.
7. Sport Fields - Drainage Considerations
  - 7.1. Where surface and subgrade conditions are dry, surface drainage will be sufficient; provide a drainage path for the run-off.

- 7.2. Where the Sports Field is located in a low areas or surface or subgrade conditions are wet, use perforated PVC under drains, granular fill and other methods necessary to create good drainage.
- 7.3. A grading plan and details shall be prepared and submitted for review and approval by the Province prior to commencement of construction.

## Section 33 71 00      **Electrical Utility Transmission and Distribution**

1. Overhead Electrical Service
  - 1.1. Overhead service may be acceptable for small buildings. Obtain approval from the Minister's Representative before proceeding.
  - 1.2. Obtain data from the Power Authority regarding point of connection, service characteristics and requirements, extent and cost of services provided by the Authority, and the best method of metering (primary or secondary, power sources etc.).
  - 1.3. Obtain approval for the following from Power and Inspection Authority having jurisdiction for the following:
    - 1.3.1. Proposed service entrance equipment.
    - 1.3.2. Switchgear.
    - 1.3.3. Transformers.
    - 1.3.4. Termination pole.
    - 1.3.5. Associated equipment.
  - 1.4. Overhead power lines shall not cross over parking lots, driveways, sidewalks, playgrounds, sports fields, or any part of a building.
  - 1.5. Keep records of all correspondence with the power authority and forward copies to the Minister's Representative.
  - 1.6. Coordinate installation with power utility and include their costs. Provide hardware as required for a complete operating system.
2. Underground Electrical Service
  - 2.1. Where incoming main electrical service must be underground including the following:
    - 2.1.1. primary/secondary runs to/from pad mounted transformer,
    - 2.1.2. primary/secondary runs to the building,
    - 2.1.3. primary/secondary runs from existing utility poles, unless an overhead electrical service has been approved by the Minister's Representative. Cable and installation shall be to the approval of the

- Power and Inspection Authorities. Provide spare ducts for future additions or maintenance.
- 2.2. Obtain data from the Power Authority regarding point of connection, service characteristics and requirements, extent and cost of work provided by the Authority, whether a transformer vault or exterior pad mounted equipment is required and the best method of metering (primary or secondary, etc.).
  - 2.3. Obtain approval for the following from the Power Authority and Inspection Authority having jurisdiction:
    - 2.3.1. Proposed service entrance equipment.
    - 2.3.2. Switchgear.
    - 2.3.3. Duct-manhole systems.
    - 2.3.4. Transformers.
    - 2.3.5. Termination pole.
    - 2.3.6. Associated equipment.
  - 2.4. Keep records of all correspondence with the power authority and forward copies to the Minister's Representative.
  - 2.5. Existing Services: Obtain and indicate on drawings the locations of all buried services, i.e. power, telephone, cable T.V., water and sewer lines, gas mains, etc. Contractor is to take necessary precautionary measures prior to commencing with any types of excavating.
  - 2.6. Duct Systems: Determine the size and location of incoming underground service ducts for power, telephone, cable T.V. and indicate them on the associated construction documents.
  - 2.7. Show trench details for all underground services. Clearly define the electrical contractor's scope of work.
  - 2.8. Coordinate installation with power utility and include for all costs. Provide all hardware as required for a complete operating system.



## Section 33 80 00      Communications Utilities

### 1. Incoming Telephone Service

- 1.1. Overhead or underground service to match the electrical service. Underground service is required if a security system is being used. Installation should be to the approval of the Telephone Authority. Provide spare ducts for future additions or maintenance. Obtain data from the Telephone Authority regarding point of connection, service requirements and extent and cost of services provided by the same Authority.
- 1.2. Overhead telephone lines shall not cross over parking lots, driveways, sidewalks, playgrounds, sports fields or any part of a building.
- 1.3. Existing Services: Obtain and indicate (on drawings) the locations of all buried services, i.e. telephone, power, water and sewer lines, gas mains, etc. Contractor is to take necessary precautionary measures prior to commencing with any types of excavating.
- 1.4. Duct Systems: Determine the size and location of incoming (underground) service ducts and indicate them on the associated construction documents.
- 1.5. Show trench details for all underground services. Clearly define the electrical contractor's scope of work.
- 1.6. Keep records of all correspondence with the Telephone Authority and forward copies to the Minister's Representative.
- 1.7. Coordinate installation with telephone utility and include for all costs. Provide all hardware as required for a complete operating system.
- 1.8. Provide active telephone lines until the end of the warranty period to accommodate the following:
  - 1.8.1. Elevators
  - 1.8.2. Mechanical Controls
  - 1.8.3. Fire Alarm / Security
- 1.9. Where a main communications room is provided, the telephone service is to terminate at this location, i.e. the demarcation point is to be located in the main communications room.

**END**

## DIVISION 48 - Electrical Power Generation

### Section 48 14 00 Solar Energy Electrical Power Generation System

#### 1. General

1.1. Where the system designer wishes to deviate from the requirements identified below, a request for variance form shall be submitted together with the proposed system riser diagram, detailed technical information on all components of the proposed standard of acceptance and shall include a narrative describing the advantages of the proposed system.

#### 1.2. References

1.2.1. American Society for Testing and Materials (ASTM) latest edition of the following:

1.2.1.1. ASTM E1038, Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls.

1.2.1.2. ASTM E772 Standard Terminology of Solar Energy Conversion.

1.2.2. Canadian Standards Association (CSA) latest edition of the following:

1.2.2.1. CSA C22.1, Canadian Electrical Code, Part 1.

1.2.3. Institute of Electrical and Electronics Engineers (IEEE):

1.2.3.1. IEEE 519-14 Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

1.2.3.2. IEEE 1547-08 Standard for Interconnecting Distributed Resources with Electric Power Systems.

1.2.4. Nova Scotia Power Incorporated, latest utility requirements.

#### 2. Products

2.1. Photovoltaic (PV) systems are to be sized to conform with utility and regulatory requirements.

2.2. Include any required applications, submissions, and all associated fees for Utility net metering (as required) in the contract documents.

- 2.3. The electrical characteristics (voltage / phase) of the PV system shall match the electrical characteristics of the service entrance for the facility.
  - 2.4. Each photovoltaic string / array is to be provided with a disconnect switch.
  - 2.5. Wiring from each string / array disconnect switch to the branch circuit panelboard is to be run using PVC or galvanized rigid steel conduit.
  - 2.6. Provide a dedicated panel board(s) for photovoltaic distribution. Each PV string / array is to be connected to its own dedicated branch circuit breaker in the panelboard(s). Provide lock-off devices for each circuit breaker. Identify panelboard(s) with a lamicaid reading "PV Panel connection only". Provide dedicated PV distribution panelboard(s) where multiple, individual branch circuit panelboards are required for PV distribution.
  - 2.7. Provide a "Reverse Feed" dry core transformer for the PV array distribution connection (as required). This transformer is to be specifically designed for a reverse feed application, do not use a standard dry type transformer connected in reverse. The PV distribution system will feed the primary of the transformer.
  - 2.8. The photovoltaic system shall include anti-islanding equipment and / or grid dependent inverter(s) except where electrical storage systems are used. Where electrical storage systems are included in the distribution system, the distribution system shall be equipped with an automatic transfer switch to isolate this power supply.
  - 2.9. Total Harmonic Distortion of the PV system is not to exceed 5%.
3. Execution
- 3.1. Ground mounted solar arrays are the preferred method of system installation. Building mounting of solar arrays is to be pre-approved by the Minister's Representative. Where building mounted solar arrays have been approved, provide metal snow guards as necessary (based on roof and / or solar panel slopes) to ensure the release of accumulated snow is controlled.
  - 3.2. Provide a PV system single line diagram (minimum size 600 by 600 mm) framed in Plexiglas. Locate in main electrical room.
  - 3.3. Provide a permanent, weatherproof, UV resistant, PV system single line diagram sized 300 by 300 mm located adjacent to the solar array.
  - 3.4. Provide safety signage.

